The Province of Alberta

IN THE MATTER OF "THE NATURAL GAS UTILITIES ACT"

—and—

IN THE MATTER OF an Enquiry into Scheme to be adopted for Gathering, Processing and Transmission of Natural Gas in Turner Valley

G. M. BLACKSTOCK, Esq., K.C., *Chairman*

Dr. E. H. BOOMER, F.C.I.C., *Commissioner*

Session:

CALGARY, Alberta March 14th, 1945.

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I N D E X

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Wednesday March 14th, 1945.
10 o'clock A. M.

Opening Remarks.
Dr. D. L. Katz
Cross-Exam.by Mr. Chambers.

MR. FENERTY: If the Board pleases, before the evidence is proceeded with, I have spoken to Mr. Chambers, and advised him that I would speak to this matter. It is with reference to the motion to be returnable on Monday next. I have spent a good deal of last evening considering this and I feel that the motion will be decided under the provisions of the Act although I think I was quite right in saying some of this work was a public utility in 1942, following Amendment, but as I say my view is that it falls within the four walls of this Act. From what I have heard that certain Amendments have been made, some of which go direct to whether or not the operations of the absorption plant will be considered as coming under the Act but will be dealt with by the coming Legislature and it may be that my problems may be determined one way or the other by those Amendments and I would suggest that under those circumstances that I be permitted to withdraw the application with leave to renew it or another application because it might perhaps be that the Amendment would make jurisdiction clear and make unnecessary any reference to 1942 and 1943. That can only be determined when those amendments are clarified.

DR. D. L. KATZ, cross-examined by Mr. Chambers.

Before I proceed with my further questioning of Dr. Katz just for the purpose of the record I would like to draw attention to the fact that there is an error in the heading on each of pages 626, 627 and 628 in Volume 9 of

the transcript which credits me with that line of cross-examination. It is really Mr. McDonald. My cross-examination starts at page 642.

Q Dr. Katz, when we rose yesterday I was in the course of asking you to turn to page 2 of your supplementary report which has been marked as Exhibit 35. Now as I understand it, instead of using the straight arithmetic averages you there use an average based on the acreage assigned to the well by the Conservation Board. Is that right ?

A That is right in this report.

Q Why did you make that change ?

A Well the question came up in reading the other reports as to which was the correct method and I tried this method to see what it would do and felt, and I knew the answer of course would be raised by taking the average.If the average pressure were higher in two of the areas it made no difference and in another one it made twenty pounds difference.

Q Then what you did there is in effect one step nearer the use of the weighted average method is it not ?

A Yes it is one step, that is right.

Q And as a result of that change in method as shown on page 1 of Exhibit 35 you increased your estimate of the gas cap reserve from 210 billion to 215.2 billion cubic feet as of January 1st, 1945. Is that right ?

A That is part of the reason for the change. I mean that is included in the change, yes.

Q Now for the purpose of your Exhibit 33 which is your

original July report of 1941. In including the average reservoir pressures as of July 31st of each of the years 1942, 1943, you used the arithmetic average of the reservoir pressures as computed for the individual wells as of July 1st in each year, did you not ?

A Yes there was a difference in part, one of them being computed the average well head pressures and correcting the average and the other one being the average of the bottom hole pressure in the last two years.

Q In 1942 and 1943 ?

A Yes.

THE CHAIRMAN: You mentioned Exhibit 33. You meant 34 did you not ?

MR. CHAMBERS: The number 34 is the July report and 35 is the March 1945 report, I am sorry.

Q MR. CHAMBERS: Then referring back to Exhibit 34 after having so obtained the average reservoir pressures for all those years down to 1943 you then used the pressure drop volumetric withdrawal method in order to compute the wet gas reserves of the gas cap recoverable to 100 pounds per square inch abandonment pressure. Is that right ?

A Yes sir.

Q And according to Item 12 of Table 1 on page 9 of Exhibit 34, you arrive at 221 billion cubic feet of wet gas recoverable from the entire gas cap down to the last 100 pounds pressure as of July 1st, 1944. Is that a correct interpretation of page 9 of Exhibit 34, Item 12 ?

A I think it is right excepting that it is recoverable gas as of December 31st, 1943. Did you say July 1944 ?

Q No I meant to January 1st, 1944 ?

A Well that is correct then.

Q And then in Exhibit 35, by reason of the other method adopted in that Exhibit that 221 billion figure as at January 1st, 1944 became 226.2 billion. There was an increase of 5.2 billion, was there not ?

A Yes.

THE CHAIRMAN: Don't you think you should clarify that. I cannot quite follow that 221 increase.

MR. CHAMBERS: 226.2.

THE CHAIRMAN: Where do you get the 226.2 ?

MR. CHAMBERS: I am relating this to January 1st, 1944.

DR. BOOMER: Where does the 226.2 figure appear in Dr. Katz report.

MR. CHAMBERS: I do not say it necessarily does. I am asking him and he agreed with me.

MR. BLANCHARD: That is by applying the change in method in the supplementary report.

MR. CHAMBERS: And adjusting the actual production for ?

A It is the 215 billionof the gas cap plus the 11 billion production for 1944.

Q MR. McDONALD: Give me that again please.

A It is the 215 estimated reserve January 1st, 1945 plus 11 billion production from the gas cap during 1944.

Q MR. CHAMBERS: Which do you consider where the arithmetic averages or weighted averages reservoir pressures are more representative in this particular case in Turner Valley ?

A As the figures show they make no difference for the two of the areas where the wells are fairly closely drilled and drilled most of the acreage of the area.

Q But if you had more time would you not under ordinary circumstances in dealing with this field have preferred to use weighted average pressures ?

A Well I probably would prefer to use the weighted average in terms of assigned acreage around a well, not necessarily the assigned acreage that had been assigned by the Conservation Board - but how far a person would go with that would have to be considered.

Q Well would this be a fair way to put it, that you would probably not quarrel with a person that had estimated his reserves on either one or the other basis ?

A No I think they can both be considered as figures that can be looked at and considered in their turn.

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Q Can you tell me this. Can you give me to what amount your reserves of 226.2 billion as of January 1st, 1945 would be increased if the weighted average reservoir pressures had been used in place of arithmetic pressures.

A I used the weighted average on the assigned acreage.

Q And applied that to the whole field?

A Yes.

Q I note that on page 6 of Exhibit 34 that you estimate the gas as down to 100 pounds reservoir abandonment pressure. Is it your opinion that gas can be economically produced down to that pressure?

A It is.

Q On page 7 of Exhibit 34, you state that 52 billion cubic feet will remain in the gas cap after the abandonment pressure of 100 pounds. Are we correct in taking it that this represents the volume of gas remaining in the formation between the abandonment pressure of 100 pounds and zero pounds reservoir pressure?

A That is right.

Q Now coming to crude oil gas reserves. I note that on page 13 of Exhibit 34 you give estimates for crude oil wells to an abandonment of 24 hour bottom hole pressure of 250 pounds.

A Yes.

Q Can you give me an estimate of what would be the average production of a crude oil well at that pressure?

A I have not given that matter very much study and it would depend a great deal on compressor capacity

and a lot of other items.

Q Well could you give us a horseback figure.

A No, I do not think I would care to do that. I could probably work something out.

Q As I understand it this matter will be of considerable interest to all of us before this Hearing is over and without being impertinent or anything, I would like to suggest that the witness give some thought to that matter and he may be questioned upon it at another time.

MR. BLANCHARD: That is how many oil wells at 250 pounds will be abandoned?

MR. CHAMBERS: That is right.

THE CHAIRMAN: Can't you get this from your own witness?

MR. CHAMBERS: I might, but Dr. Katz is being called as an expert representing the commission and I think I can say this, without casting any reflection on anybody, that if I can get an estimate or a judgment of the Commission's witness, whom I assume for the moment at any rate has no interest one way or the (Go to page 676)

other, and the evidence may or may not of course have more weight than if it came from another witness.

Q Dr. Katz, at the bottom of page 33 of Exhibit 34, you mention an acreage of 9,920 acres for the oil area. Can you give me some indication as to the limits of the acreage that you have included in that 9,920 acres of oil area?

A I think that is the area assigned to the oil wells, allowing a well at 40 acres. Now that acreage does not mean necessarily the acreage of what the bounds of the oil field may be some day.

Q It comprises the assigned acreage according to the records of the Conservation Board?

A Yes. And it is the amount of acres figured at 40 acres per well with a few at 20 acres per well I believe.

Q And what allowance did you make in making your crude estimates as to the drilling of new wells?

A In the three areas upon which the Material Balance calculations are made, the crude oil that is in those areas or contiguous with it will exert some influence more or less upon the crude area which I am studying,, to the extent that that oil has or has not been tapped by wells has exerted an influence on the reservoir which I studied by maintaining the pressure or putting a fluid into that area, I have considered it but if it has not exerted any influence, although it may be contiguous with it,

I have not considered it.

Q This question of assigned acreage is a bit confusing to me as a layman for reasons you probably understand, but am I correct in assuming this, that your estimate of crude gas to be recovered is your estimate of what will be recovered from the 9,920 acres?

A Well, I will repeat what I said before, that if there is oil in the area adjacent to one of these wells or in the North end which has not been drilled and therefore acreage is not assigned, if there is oil in that area, if you drill a well there and find the pressure at the original pressure of the reservoir in that particular place that has not been taken into account of the oil and gas in that area. Whereas if you would drill that well and find that pressure was higher than the well which has already been drilled but lower than the original pressure, I have partially taken that oil area into account. As I tried to say a minute ago, I have taken it into my calculations in so far as that oil has exerted an influence upon the wells that are already drilled.

Q Turning to page 16 of Exhibit 34, Table 4, in your Material Balance calculations for the B.A. Oil area. I note that by using the data available as at January 1st, 1944, you estimate 120.4 billion cubic feet of gas which will be produced from 2,720 pounds to 250 at bottom hole pressure, that is correct is it not?

A I am not certain, will you repeat those numbers?

Q It is on page 18.

A Yes, but the numbers.

Q By using the data available as at January 1st, 1944, you estimate 120.4 billion cubic feet of gas will be produced from 2, down to 250 pounds bottom hole pressure.

A Yes, that is right.

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Q Now what would your estimate have been taking the volume of gas released in that area between those same pressures, that is the twenty-seven hundred and twenty down to two hundred and fifty and based on the data which you have used in Table 4, as of June 30th,1940?

A As of June 30th, 1942?

Q June 30th, 1940?

A It would have been sixty-eight billion.

Q Sixty-eight billion. Now what would your estimate have been if you had used the data as shown for June 30th, 1942?

A A hundred and ninteen billion, excuse me --

Q I think you are a little high, one hundred and one I have,

A Excuse me, I made a mistake, one hundred and two billion.

Q Yes.

Q MR. HARVIE: Those figures are being computed by you, they are not in your report?

A That is right, I am computing them right now.

Q MR. CHAMBERS: Now how much gas has been realized or produced from the B.A. oil area up to January 1st, 1944, I think the information is probably on page 15, is it not?

A The quantity, - will you repeat that question.

Q How much gas has been realized or produced from the B.A. oil area up to January 1st, 1944?

A The gas production on page 16, I have seventy billion.

Q Yes. I notice here on page 16 you have 70.5?

A 70.5, yes.

Q Now is not that amount greater than the total reserves in that formation which you would have estimated using the data available as of June 30th, 1940?

A I think so. I do not recall the exact figure. I can compute it, 68, was it?

Q- 68, yes?

A Yes, it is two billion more.

Q Now the same would be true with regard to this G.O.P. and the South Royalite area and in that connection I refer to table 5 on page 17?

A MR. BLANCHARD: 18, is it not?

Q MR. CHAMBERS: Well 17 and 18, table 5?

A The same sort of calculation could be made, yes.

Q And that would apply also to the North Turner Valley area north of Sheep Creek, I take it from table 6?

A Yes.

Q And the north Turner Valley south of Sheep Creek?

A Well yes, although in, - I did not make calculations of the same kind there but in general it probably would be true.

Q Now is it not true that the difference in calculations or the difference in the calculated reserves using the 1940, the 1942 and the 1944 data, just mentioned, is due to or is the result of incorrect assumptions?

A It is the result of the pressure in the reservoir being higher than the average bottom-hole-pressure used to a large degree.

Q Well let us put it this way, at least there is a

difference at different times?

A Yes, of course there is a real reason --

Q Oh yes?

A You understand that.

Q Yes?

A I would not use the 1940 bottom-hole-pressure as representing the average reservoir pressure to anywhere near the extent that I would use the 1944 value.

Q Then also there would be similar differences which would arise if you were making future calculations?

A Yes, but to a lesser degree. The 1940 values were put in but you will recall I have nowhere in my report, except as a matter of information, quoted those figures as being the value and I state in my report I believe that the method, the inherent method, is a fact that as time goes on the reserve does rise but there is a point in that rise in value where it will not rise materially and I feel that as of the first of this year, 1945, that we are approaching that point where the future reserves as computed by this method will not rise anywhere near to the extent that it has risen from 1940.

Q Yes?

A To 1945.

Q Well let us assume you were making an estimate we will say as of the first of January 1946, you would still have some difference from what it is now?

A Yes, and probably it will be larger.

Q And in fairness the same thing probably applies to the other methods used, the more information you have

the nearer you can get to what you think is correct?

A That is right. The method that I have used indicates that the gas is there for certain and is not intended to be the maximum value.

Q You told me before that is one of the reasons that you erred or you felt in making your judgment you erred to be on the safe side?

A That is right.

Q Now Dr. Katz, going again to page 16 table 4 of exhibit 34, you were assuming as I understand it, that 47 millions barrels of oil will be produced in the B.A. oil area?

A What page?

Q Page 16 on mine?

A MR. BLANCHARD: It is page 17.

Q MR. CHAMBERS: Oh, table 4, it is on page 16 of mine?

A For the record it should be stated that I am using the typed copy of this report and there may be an occasional difference of paging.

MR. BLANCHARD: Yes, mine is a page out.

Q MR. CHAMBERS: It is on table 4 in any case which only occupies one page.

A The figure which I see here is 42.-no, that is the gas, - we assume 47 million barrels of oil production in order to get the volume of the gas space in the reservoir which in turn is used to compute the small volume of gas which remains in the reservoir at abandonment, which is a minor correction upon the total gas reserve and does not have anything to do

with future oil production. It is just an approximate value. It would not affect my gas reserve over a very small percentage if that were off.

Q Now that 47 million barrel assumption, you assumed would be produced between the original pressure of 2720 lbs down to 250 lbs per sq. inch?

A Yes.

Q Now is it not so that of this 47 million barrels, 18.15 million barrels have been produced as of January 1st, 1944 from that same original pressure of 2720 lbs down to the average bottom-hole pressure of 889 lbs per sq. inch?

A Yes.

Q That is right is it not?

A That is right.

Q And does not that work out at a rate of 9,880 barrels per pound drop in pressure, that is by dividing the difference in the pressure into the barrels ?

A Oh I have not made the calculation. Do you want me to make it?

Q I would be pleased if you would, Dr., can you do it now?

A Will you repeat it so I can follow the numbers and make it.

Q There are 18.15 million barrels have been produced between the original pressure of 2720 lbs down to 889, and is not the answer 9880 barrels per pound drop?

A 9900.

Q 9880?

A Thousand barrels.

Q Yes, per pound drop?

A That is what the computation gives me.

Q Yes, now that assumption of 47 million barrels also involves that there would be remaining production of 28.85 million barrels, which is the difference between the 47 and the 18.15 already produced as of January 1st, 1944, that would be correct would it not?

A The difference between those numbers, yes, that is right. For the purposes of my computation, it is a very minor correction of the total gas reserves for the area and has no other bearing upon any of this report.

Q I am just asking you what the consequences of the assumption might be?

A Yes, but I say you are implying something in your question --

Q I am not implying anything, I am taking the conditions and just drawing an inference?

THE CHAIRMAN: Go ahead doctor?

A I do feel that you are implying that I am saying that the oil recovery in the field is 47 million barrels for estimates, whereas this is only a figure which had to be applied to get some idea of the pore space to correct the volume of gas remaining in the reservoir, which correction is a very small figure, so that I really do say to take about 25% recovery, without a study of the oil recovery

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Q It was one of the assumptions that you were making for the purposes of compiling your report?

A Yes.

Q But whether that assumption was good, bad or indifferent these matters that I am putting to you would flow fromm that assumption, assuming the assumption was correct, is that not so?

A Yes, but if this particular assumption were totally incorrect, it would change my gas reserves by a very small amount.

Q But the assumptions, therefore, must necessarily imply for the purpose of this table at least, that there is 28.85 million barrels of the 47 million still to be produced?

A That is right.

Q Between a pressure of 889 pounds and down to 250 pounds?

A That is right.

Q And the pressure rate on that basis, I suggest to you, is 45,000 barrels per pound drop, would that be approximately right do you think, Dr. Katz? It is 28.85 million on a drop 889 and 250?

A 40,000 barrels.

Q I had 45,000?

A All right, 45,000.

Q Between forty and forty-five?

A Yes.

Q Now turning to Table 5, which is on the next page, the latter part of the Table, that is probably on your page 19, Doctor, it is on my page 18, of Exhibit 34.

That is the G.O.P. and the South Royalite area?

A That is right.

Q And a similar assumption made there is that 40 million barrels total oil production from the original pressures of 2700 pounds down to 250, is that right?

A That is right.

Q And of this 40 million, 16.71 million have been produced down to January 1st, 1944?

A That is right.

Q That is from a pressure, an original pressure of 2700 pounds down to 981 pounds, that is right, is it not?

A That is right, 981; that is right.

Q And my computation shows me that that is an average of 9720 barrels of oil per pound pressure drop, would that be roughly correct, do you think?

A It sounds reasonable, yes.

Q That assumption would also involve a remaining production of 23.29 million barrels of oil between 981 pounds down to 250 pounds, or 31 thousand odd barrels per pound drop.

THE CHAIRMAN: Mr. Chambers, I do not want to interrupt you, or tell you what to do in your examination, but I am not a bit interested in what happens to the oil or what is produced.

MR. CHAMBERS: I know, and I am not interested in that at all but I am interested in testing Dr.Katz.

THE CHAIRMAN: Then what are you getting the information for?

MR. CHAMBERS: I am testing the assumptions that he has made. I am not necessarily interested in the information, I am drawing the differences.

THE CHAIRMAN: It is a mere matter of arithmetic.

MR. CHAMBERS: I am entitled to have it on the record, I submit, as the result which flows from certain assumptions that he has made and then I may have something to say later on on that. The Commission may not agree with me but I am entitled to present it for what bearing that has on the whole report.

THE CHAIRMAN: Well the amount of gas that will be produced is what we are interested in and not the amount of oil.

MR. CHAMBERS: Certainly, but in arriving at the amount of gas you have to come, I submit, to some conclusions as to which of the estimates put in by the different experts or the engineers should be adopted. And I do submit that it is of assistance to this Court to bring out by cross-examination various consequences that flow from those assumptions and to test how good the assumptions are.

THE CHAIRMAN: Well I understood Dr. Katz to say that any variation of those assumed figures would have a very different effect on his final result, is that right?

WITNESS: Yes, of gas reserves in the area.

MR. CHAMBERS: Well I will have something to say about that later on. I am not suggesting that Dr. Katz does not know what he is talking about, not for a moment, but after all I have to satisfy you as a layman, by processes of reasoning, whether it is good or bad. It is for you to say.

Q Now,Doctor, I suppose you also assumed certain oil

production from the North Turner Valley, North of Sheep River? I do not think your report, Exhibit 34, gives any amount, but I at least would like to know first of all whether you did make an assumption in that regard?

A I made an assumption in order to find the volume of gas space at 250 pounds, I could find a small amount of gas in that area at the 250 pounds. On page 17, 18 I think on your report, I have the volume of gas in the final cap at 250 pounds as 9.7 billion. This volume of gas is contained in the space that has been vacated by the vapourization of gas from crude oil, which I got by the difference in shrinkage, and also gas from an assumed quantity of oil production, which assumed quantity will be less than the space vacated by the gas, and the total under discussion is 9.7 billion, and if I were off approximately 30% or 40% in my oil figure, I might be off as much as a billion feet of gas.

Q Could you give me the oil figure that you did assume?

A In the North?

Q North of the.....

A At the time I was making the calculation I was using a general figure of 25%, it was not exactly that, but it was close to it, 25% of the oil would be recovered.

Q 25%?

A Yes, of the oil initially in place there, assuming approximately 25%, which you will see the figures are roughly 25%.

Q And that figure, I suppose, by applying the - if I were asking you the same questions about that as I have asked you about the B.A. Oil area and the G.O.P., somewhat the same results would follow?

A Yes, I think so.

Q The significance of them, that is another matter?

A That is right.

Q DR. BOOMER: Dr. Katz, is 25% recovery an ordinary thing?

A Yes, as a general practice 25% is low, although in this particular field it may be a bit high, but I think it is a reasonable figure which people might take without having particularly studied the matter of oil recovery itself.

Q Is 45,000 barrels per pound pressure out of the ordinary?

A Not that I know of, no.

Q It means that at least the Turner Valley field has been operating.

A Well as a matter of fact in a gas drive field that has no gravity segregation, there is no relation of oil recovery to pressure drop. In a field where the formation is tight there might be some relationship but I think that no general conclusions can be drawn.

Q MR. CHAMBERS: Dr. Katz, when you are talking about the 25% recovery, you are referring now to the assigned acreage, you were not referring to the whole area, the over-all area of what is known as Turner Valley?

A I am referring to the initial oil content in place

calculated by the material balance calculation. That is what it is applied to.

Q Well this 25% is 25% of some over-all figure for Turner Valley as a whole?

A Yes, I would say as to the active crude reserves that have been indicated by the wells drilled.

Q By the wells drilled?

A Yes.

Q And you took from that the whole 17000 acres, and I am informed that is the acreage in Turner Valley, crude area?

A Well you are asking me the question and I answered a few moments ago as to what my calculations included, and they include the oil which has exerted an influence upon the wells which have been drilled, whether that oil is in the assigned acreage or whether in the remainder.

Q And how did you arrive at 25%, please, of recovery?

A Just from general knowledge of the recovery of various fields.

Q And what about this field?

A Well for the purposes of this calculation I did not make a detailed study of what I thought the oil recovery would be on a percentage basis, and, as a general proposition, I used 25%, because whether I would have used 15 or 25, or 35 for it, made a minor difference in the gas reserves, and this report was on gas reserves in Turner Valley and not upon oil reserves.

Q But as I understood you to say in answer to Dr. Boomer,

that you thought the 25% was the proper percentage, Now you must have given some consideration to that when you arrived at it, or is it just a horseback figure?

A 25% is the figure that was arrived at in the 1939 report, as a general figure which has been used early in the life of the field.

Q And you would not be in a position to tell me whether that 25% would be more or less if you were making the estimate now?

A Well I can tell you what the other folks have got, and it is less.

Q I am asking you?

A And they have made a thorough study of what the oil reserves in Turner Valley are, but it has not been necessary in the work I have done, a thorough study to get the exact value that I feel would be the best value, and this figure was the figure which entered into my calculations in a minor way, and therefore I did not go to the effort of spending a large amount of time to arrive at a better figure than 25%.

Q Well now, do I understand for the purposes of your report, Exhibit 34, you have actually assumed that the average 24 hour pressures of the individual wells were representative of the entire reservoir oil respective areas, is that right?

A That is right.

DR. D. L. Katz,
Cross-Exam. by Mr. Chambers

Q Now is it not true, Doctor, that the material balance method is not entirely satisfactory in limestone fields with low permeability such as Turner Valley crude area ?

A Well if you feel that using the pressure data that we have and the methods we use which will probably be on an increasingly reserve in time is an unsatisfactory method then I believe this would have to be called unsatisfactory.

Q Well what I mean by that unsatisfactory because of the reason of a slow approach of this kind of reservoir to equilibrium pressure which makes it difficult to ascertain the true pressures on the basis of shut-in periods of practical duration ?

A Yes it does mean that the error in calculation in a tight formation due to this effect of having the reservoir pressure somewhat higher than the shut-in pressures in the wells is greater than it would be if made at a loose sand where pressure gradients and difference between shut-in pressures and short time, long time, and of ordinary magnitude of ten and fifteen pounds, that is right.

Q And that is what you had in mind on page 14 of your report, Exhibit 34, which says:

> "The shortcoming of the material balance calculation for the oil area is the use of 24 hour shut-in bottom hole pressure for the reservoir pressure."

A That is right.

Q Now on that same page that I have just referred to,

you refer to water encroachment and you said as I understand it in your view that it will off-set the low 24 hour shut-in pressure. Do I infer from that that you consider there is considerable water encroachment in that area ?

A No I think it reads water encroachment into the reservoir to the extent it has taken place will off-set the effect of the low 24 hour pressure. I did not mean to infer that it is of equal quantity by that statement. I did not infer that as of comparable magnitude necessarily to the difference to the reserves which I would get if I had the true reservoir pressure.

Q But in making your computation and assumption you more or less adopt that one thing off sets the other ?

A No I did not to the extent it has taken place will off set. I do not mean that if one off sets another. I do not mean it is equal to it but to the extent that it occurs it is on the opposite side of the ledger. That is what I mean to imply by that term.

Q I know, but what I am getting at is this, the effect of water encroachment to the extent it has taken place as I understand it, and you say that would more or less off set the short coming of the calculation based on 24 hour shut in period.

A If your understanding of that statement is that it is equal in magnitude then I did not mean to say that but to the extent that it takes place it is on the opposite side of the ledger and will off set it to the extent that it takes place.

Dr. D. L. Katz,
Cross-Examined by Mr. Chambers.

Q But you are not implying that if you had had the pressures obtained by long shut in periods the difference as between that figure or between your computation on that basis, and your computation on the basis of the 24 hour shut in would be taken care of by the assumption that you have made in connection with the water encroachment that has taken place. You think there has been some water encroachment ?

A Well to a minor degree. I have not felt it affected the reserves materially.

Q That it has not ?

A No I do not think it has affected the reserves materially.

Q Now on page 23 of Exhibit 34, probably on another page of yours, you assume the shrinkage factor of 15% for the gas cap wells, wet gas, and 30% for crude for the purpose of converting the wet to a dry gas basis. Now, Doctor, as I recall it on Monday in Volume 8, page 553, you were going to give a break down but something came up and my learned friend advised me he might have for us that later. And I am interested in how you arrive at that 30% figure ?

A I do not recall the detail of it and I do not know that I have it.

Q I will just read from Volume 8 starting on page 552:-

"Q Have you broken down the figure of 30%, I mean now what percentage is used of unrecoverable gas as a lump sum?

A I don't know as I have because I was thinking of it in terms of areas. In one area

you will have a different fuel consumption than in another. Probably it is somewhere about five or eight per cent of the total wet gas will be ungathered.

Q-Then you would have that as unrecoverable gas ?

A-Yes.

Q-So that when you say there is so much residue gas you are putting it forward as recoverable residue ?

A-Yes.

Q-In breaking that down, the residue gas in the various areas, the areas of the field, that is broken down somewhere in the report, perhaps you can take the figures I have, Doctor, take the B. A. area, I think you have a total for the gas cap here of 28.6 and taking 85% of that, that would leave you 24.3 billion cubic feet residue gas in the B. A. gas cap ?

A-Yes. For the supplemental report, is that right ?

Q-Well I would not ask you.....

A-24.3 billion, yes.

Q-Haven't you got those ?

A-I haven't computed those.

Q-We can submit that perhaps as a computation afterwards.

A-I computed it in pencil, I am sorry. I put it on my summary sheets. If you would like me to read it I have found it now.

Q-The summary to the supplemental report ?

A-Yes, I have computed it in pencil on my own copy.

Q-Well you do not need to read that memo at the present time....."

All I am anxious is to get some idea of the work done or how you valued that 30% ?

A I do not think the latter refers to the 30%. I think the latter refers to the residue gas from the various areas. The latter part of the statement you have been reading.

Q I beg your pardon ?

A The latter part of the statement you were reading from the record to my recollection refers to the residue gas reserve by areas which figures I have in my summary sheet but I did not have the breakdown of the fuel consumption, the extraction loss and the ungathered gas as being part of the 30%.

Q But your 30% includes the allowance you have made for ungathered gas ?

A That is right.

Q But you have not worked that out on a percentage basis or as to what part of the 30% ?

A I have done nothing further since the questions were asked me. That is right.

Q Now, Doctor, assuming that the actual 1944 production of dry gas delivered to the market was 7.9 billion from the crude area, have you that figure. The actual 1944 production of gas from the crude areas ?

A I do not know. I have not it exactly. I think the

production of gas from the crude area in Turner Valley is 29 billion, I think. I am not positive.

Q Delivered to the market. I am talking about the market. Well I won't bother about that. All I want to do is get it on the record and if my learned friend can get it for me I am ready. My figuring is that the actual 1944 production of dry gas delivered to the market was 7.9 billion from the crude area and 8.2 billion from the gas cap area.

MR. DAVIES: Dry gas?

MR. CHAMBERS: Yes, dry gas.

Q Now, Doctor, through my learned friend whom I asked to have a break down by areas and my learned friend has h nded these to me and I will put them to you for the purpose of getting them down on the record. And this is the question. Can you now give me the dry gas reserves as at January 1st, 1944 in each of the following areas on the basis of Exhibit 35. Those are the figures.

A That is a copy ?

Q Yes. That is January 1st, 1944. On the basis of the computation in Exhibit 35. We will take the B.A. area first, the crude is 44 billion and the gas cap 29.9 billion ?

A That is right.

Q And the Mayland or G.O.P. area, the crude would be 16.5 and the gas cap 19 ?

A That is right.

Q And what we call the Madison area, the crude would be ?

A 155 billion.

Q 155 billion and the gas cap 177.3 billion ?

A That is right.

Q That is the breakdown ?

A Yes, there is some question on the crude area in the B. A. area and the crude oil in the Madison area since the method of my computations in the supplementary report as compared to the July 1st, 1944 report were not made by cumulative production, but were independent calculations from the wells and there is a slight question on that, but substantially right.

Q Frankly I want to corelate with you the way some of the other estimates are put in. That is all.

A Yes sir.

(Go to page 699)

Q Dr. Katz, on page 22 of Exhibit 34, that is the page headed "Extension of Gas Sales by Conservation", you estimated that 41.8 per cent of the gas produced during the first 4 months of 1944 actually is marketed during that period?

A That is right. I assume only 41.8 per cent of the total of the gas reserves, which is 401 billion to go to market or 168 billion.

Q Yes, on the information furnished which is qualified on the basis of present degree of conservation.

A That is right.

Q And at the rate of 12 billion per year the life for market purposes was 14 years.

A Yes.

Q And applying that same method to your revised estimate for January 1st, 1945 of 41.8 per cent, we will assume of the wet gas that will go to market will be 41.8 or 406 billion is it not?

A That is right.

Q And you got 169.8 billion?

A That is right.

Q As at January 1st, 1945?

A Yes sir.

Q Which would work out as I understand it by dividing the average of 12 billion per year into 14.1 years from January 1st, 1945?

A That is right.

Q Now then, based on the conservation set-up, that is the set-up we now have or are setting up under the Act you estimate in your evidence and arrive at a life of 26.4 from January 1st, 1945.

MR. BLANCHARD: That is 12 into 316.6.

MR. CHAMBERS: Yes, I took it into 317.

Q Now then on page 1 of Exhibit 35, the supplemental report . . . . .

MR. BLANCHARD: Did you answer that?

A I did not check the figures quite. Are you referring to a page in my report and can I refer to the number without remembering it.

MR. CHAMBERS: No, there is no figure.

A You are referring to a calculation.

Q I took it at 317 billion cubic feet on your revised estimate of dry gas recoverable, January 1st, 1945 and divided that by 12 and would give you a life of 26.4 years.

A All right.

Q On page 1 of Exhibit 35, you show the total Madison reserve, that is the Royalite gas cap as I understand it in the crude area as at January 1st, 1945 at 308.8 billion wet gas, that is right is it not?

A That is right.

Q And on a dry gas basis that would work out at 241.5 billion.

A It would be 15 per cent of the gas cap, or 85 per cent of the 168.7 plus the other. I think that is in my report, but that is the way it would be. It sounds right but I have not made the calculations.

Q 241.5 applied 15 per cent to the gas cap and 30 per cent to the crude?

A Yes.

MR. BLANCHARD: 241.3.

MR. CHAMBERS: And I have 241.5 so I will not quarrel with that.

Q On the basis of marketing 12 billion feet per year that dry gas reserve connected to the Madison system would take the market for 21.1 years.

A Yes, that is right.

Q Now is it not true, Doctor, that that reserve would have been available or connected to the market we will say even if the present Statute had not been passed and this set-up inaugurated.

A I understand that there is some gas in the North end of the field, possibly some adjacent to Madison 3 that might not have been collected. It is not a material amount but it should be considered as having some value.

MR. BLANCHARD: How much was done in anticipation of the legislation? You might put that to him.

MR. CHAMBERS: Well all I can say is that the legislation was not definitely anticipated until shortly before it was introduced, which was only a year ago.

Q Now, taking that basis of 21.1 years, the Statute and what has been done under it, I suggest to you has increased the life of the field for market purposes from 21.1 years to 26.4 years from January 1st, 1945.

A Yes, in addition to this other gas.

Q Which I think you told me was negligible or was a comparatively small amount.

A Probably, comparable to the total. I have not

made an investigation of the exact amount but something that should be considered and evaluated if you wish to make this comparison complete.

Q What I am suggesting is that the Madison system would have at least - I am not arguing or suggesting the merits or demerits but I just want to get the facts - that the Madison system would have been, according to conservation and the extent of the available reserves, would have been making about 76.2 per cent. I get at that this way. There is your estimate of 31.7 billion of dry gas at January 1st, 1945./

A that is right:

Q And then we will assume the Madison system, as I understand it, 241.5 billion.

A Yes, I think I follow what you are saying now.

Q Just as a matter of arithmetic it would be 76 per cent.

A The question is I do not think it would be 76 per cent minus the amount of gas in the Madison system which would not have been gathered otherwise.

Q Yes, I will apply that to every question and answer that has taken place since you first started on this. Then I would like to direct one or two question to you on this question of migration we talked about yesterday. In volume 8, page 558, you deal with the question of migration as between the crude and gas cap areas. As I understand it, you state there that if migration of gas has taken place into the gas cap area, it will not have any material effect on your reserves, on the estimate, because you used the cumulative gas production on the initial date.

A That is right.

Q Now on that page you mention a figure of 25 billion. Now do you consider that figure is the amount of migration which has taken place, or is that just . . . .

A Well no, how I feel is it is in the order of magnitude of the quantity that might have migrated, I would say that. One cannot arrive at any definite figure. There may be some method by which a man could get some inferences as to the quantity, but it is not an exact figure. It is not 200 billion, for example, and I do not think it is one, but it is probably on the order of magnitude or 25 billion would be within the range.

Q That is what you consider probably has taken place up to date?

A Yes. I mean the figure I was thinking of from the initial time till the present, that is right.

Q One of the considerations entering into this question of migration is the question of permeability?

A That is right.

Q And I think you have already told me that Turner Valley, speaking generally, has low permeability.

A That is right.

Q And that fact minimizes the extent of the migration that would be apt to take place as between the gas cap and the crude area?

A That is right.

Q Now my recollection is, and would you correct me if I am wrong, that in answer to my friend, Mr. Steer, you stated that at the end of from 5 to 7 years from

now, the migration would be the other way. Do you recall that? Probably I should refer to the evidence, Volume 9, page 605. The bottom of page 604 and the top of page 605. "I assume it is a matter of 5 to 7 years, something like that." Just in fairness to you and all of us, I want to get on the record whether that is . . . . whether you are giving that as your opinion to this Commission?

A Yes, that if the gas production is projected in the future from the oil area and as the gas cap had very little production and even re-pressuring in the next 5 to 7 years, that the previous relationship I felt would very likely be reversed as the pressure on the gas cap would become higher than the pressure in some other area if not all of it and to the extent that the pressure in the gas cap becomes higher than the pressure in the oil area the migration would tend to reverse itself.

Q Doctor, more or less for the purposes of exploring the question of this 25 billion figure, I want to draw your attention to two or three things. Now as I understand it, Royalite No. 77 well was completed in January 1945 and that is situated in legal subdivision 1, section 2, township 20, range 3, West of the 5th Meridian, have you any idea where that well is?

A I will have to look at the map, Sir.

Q I am sure the Commission and my learned friend would not have any objection to Mr. Connell showing to Dr. Katz on the map the location.

A It is South of Sheep River.

Q Now as I understand it that well is about three-quarters of a mile West of the gas cap?

THE CHAIRMAN: Which one is it.

MR. CHAMBERS; Royalite 77, legal subdivision 1, section 2, township 20, range 3, West of the 5th.

Q MR. CHAMBERS: Now you understand or you agree that that is about three quarters of a mile West of the gas cap?

A Yes.

Q Now my information is that shortly after Royalite 77 well was completed, it had a flowing casing pressure of 1600 lbs per sq. inch at an oil production rate of 463 barrels per day with a gas oil ratio of a 1108 cubic ft. per barrel and it had an estimated bottom-hole-pressure of at least 2000 lbs per sq. inch at 2200 ft. below sea level; Now I am just giving you those certain surmises and I am not asking you to verify those facts; Now the closest gas cap well I am informed is Okalta 1 and it is about one mile East of Royalite 77, let the witness see the map?

A Yes.

Q And that it had a top-hole-pressure of 488 lbs per sq. inch in June 1944 and it had a calculated bottom-hole-pressure of 581 lbs per sq. inch at the same place, that is at 2200 ft. below sea level; now doctor what I am putting to you on those assumed facts would that not indicate to me that there is practically none if any migration in that particular area?

A It would indicate that the migration is very low in the fact that the pressure dropped probably only some three hundred pounds since the initial discovery time of the reservoir and the gas oil ratio indicates the oil adjacent to that well is a saturated liquid and in that state migration of course is very low and that area I believe generally around it is representative of the least, the lowest permeable portion of the field, although that particular well is not necessarily representative of the area.

Q Now I am going to refer you to another, Arrow #1, It is located on legal subdivision 16, section 13, township 19, range 3, west of the 5th meridian, and it was completed on March 17th, 1940, and I am informed that that well is about a mile and a quarter west of the gas cap, will you show that to Dr. Katz; Now my instructions are, Doctor, the reservoir pressure of that well in May 1940, and it was completed in March 1940, was at least 2335 pounds per sq. inch at 2200 feet below sea level and my instructions also are that the nearest gas cap well is A. P. Con. No.2; will you show that to the witness, - and that the A.P.Con. No.2 Well is about a mile and a half distant and that in June 1940 that A.P.Con Well had a top-hole-pressure of 432 lbs per sq. inch or a calculated bottom-hole pressure of 517 lbs per sq. inch at the same place, and A.P.Con was completed as I am informed in June 1930; now assuming the factswhich I have given you about the wells and the pressures, that those statements are correct, does that give

you any indication of the extent of migration in that area?

A That the migration is very low in that particular area.

Q Now that is all I have on that particular phase. You have a copy of yesterday's transcript before you, volume 9?

A Yes.

Q At page 629, you therein were talking to my friend Mr. McDonald on the question as to the 570 gas cap pressure and 889 crude/oil pressure down in the B.A. area; now as I understand it, the 889 pressure there referred to was an arithmetical average of a 24 hr. bottom-hole-pressure, that is what you were talking about, was it not?

A Yes, I do not know which figure it was, whether it was in the report or the supplement.

MR. MCDONALD: It was the July report.

Q MR. CHAMBERS: Now is it not true that the 24 hr. pressures in the oil areas would be considerably less than the true reservoir pressure?

A Somewhat less, yes.

Q Is it not also true that the 24 hr. pressure in the gas cap in the same area would be almost equivelant to the true reservoir pressure?

A Yes, it would be closer to it at least.

Q Therefore would it not be a longer time before the bottom-hole-pressure would exceed that in the oil area, before the bottom-hole-pressure in the gas exceeded the bottom-hole-pressure in the reservoir?

A It would be a longer time if that were true, to the degree which it is true, than if you did not recognize that it was true, that is right.

Q Now going to the question of the effect of repressuring in the gas cap on this question of migration; assuming, or let me put it this way, if the amount of gas stored in a gas cap area were to exceed the withdrawals from that gas cap area by an amount as large as 2½ billion cubic feet, what increase in pressure would be obtained if this gas were distributed over the whole B.A. gas cap area?

A I made that computation last night after discussing it with Mr. Connell and the pressure rise I computed would be in the order of 30 lbs.

Q Yes?

A The pressure rise. This is in the British American gas cap, assuming no migration and assuming that 2½ billion cubic feet of gas, which was included in the question, were the net injection into the gas cap of that area.

Q Then similarly if the amount of gas stored in the Royalite district, I mean the gas cap, that is the central part, were to exceed the withdrawals by as much as 13 billion, what increase would be obtained in pressure in that area if this gas were distributed over the total North Royalite area?

A Assuming again no migration and the quantity put in there was the net increase, it would give a 38 lb rise in the average pressure.

Q MR. HARVIE: Is that the gas cap as a whole other than the B.A. area?

A That is using what I call the North Royalite gas cap, I believe, with a net increase in gas in the reservoir of 12.9 billion cubic feet.

Q MR. CHAMBERS: Now referring --?

A I might clarify that if I might, that is based on the calculation in my supplementary report on page 4 called "The North Royalite Gas Cap" where I give the reserves as to the first of the year of 1945, of one hundred and forty-two and a half billion cubic feet. This pressure rise referred to the area which contained that gas .

MR. HARVIE: Thank you.

Q MR. CHAMBERS: Referring back to the question which I asked you about the repressuring of the B.A. area, now if it required five years before this maximum excess of 2½ billion were reached, would not a number of wells immediately west to the present B.A. gas cap be classified as gas cap wells by that time?

A Yes, the gas would be rising and if they were reclassified on a certain gas oil ratio.

Q That would be the reasonable thing to be expected?

A Yes.

Q Then in that case the increase in pressure due to the excess repressuring would be a still smaller amount than the figure you gave me, assuming again there was migration?

A Assuming migration, yes, that is right, and if mig-

ration takes place the pressure would not rise that much either, between the gas cap, the B. A. gas cap and the oil area or between the B. A. gas cap and what we have called the "G.O.P." and "South Royalite" gas cap.

Q But that might, would, tend to affect the figure which you have just given us ?

A Any migration would tend to affect the figure.

Q I am referring now to the other point I put to you, that in this period of years, four or five years, these other wells immediately to the west of the present gas cap would be classified probably as gas cap wells and in that case the increase in pressure would tend to be a smaller amount than the one you have just mentioned?

A Well if by that you are inferring that having those wells become gas cap wells, that it will increase migration, yes.

Q Therefore if the pressure in the oil area should ever become less than that in the gas cap area, the migration from the gas cap to the oil area would almost be a negligible amount, would it not, due to the fact that the differential between the two areas would be very small?

A That would depend upon whether the gas is produced from the oil area rapidly or slowly and what happens to the oil area reserve. When we know what is going to happen to the gas cap pressure, - there may be some doubt as to the figures, - it might be estimated what would happen to the figures

in the gas cap area and I have not made those calculations as much as I would like to but I do feel that the oil area pressures may become lower than the gas cap pressures at sometime down the line. It is possible that they will not. They may reach a substantial balance and not change.

Q MR. CHAMBERS: Well now, Dr. Katz, as to - let me put this to you; Even if there has been migration from the crude area to the gas cap, I suggest this would have occurred at a slow rate over a number of years, and at a fairly high differential?

A It would be slow at the beginning, because the formation contained a high percentage of oil and the pressure differential was high, and it would be slow relatively to what it might be later on because of the differential having become lower.

Q You probably misunderstood what I am driving at. From your knowledge of the field and what you have read about it and from your study of the reports, and the locations and the pressures, would you say that any migration to date,- it has been over a period of years?

A Yes.

Q That is evident?

A Yes.

Q And there has been a high differential, that is much higher pressure on the crude?

A Yes.

Q And notwithstanding all that, having regard to the nature of the field, it is relatively small to date?

A Yes, relative to what it might be in a very permeable formation. Yes, it is small.

Q Using that word relative to the 25 billion figure that you mentioned a while ago, that is relatively small?

A Yes, it is.

Q Now, is it not true that it would be a number of years

before the differential would be reversed, if at all?

A Yes. it would be a number of years before the differential would be reversed.

Q And if that condition should ever occur, the differential in the other direction would be very small?

A Yes, the differential would be small, but that would be partially offset by the fact that the formation through which the gas is going to migrate, contains a lower percentage of liquid, which will facilitate the migration over what would have taken place earlier in the life of the field, when a higher percentage of liquid was present in the pore spaces.

Q Now is it not also true that by that time, that is when the differential swings where it is higher in the gas cap, the wells that would be most affected by migration would be gas cap wells, and oil production from them would then be a secondary factor or consideration?

A I am not quite sure I have the question. Would you repeat that question again?

Q Is it not also true that by the time, by that time, the wells that would be most affected by migration in the reverse direction from the gas cap to the crude area, would be gas cap wells and oil production from them would then be a secondary consideration?

A Yes. The gas migrating from the gas cap obviously goes by the upper wells in the oil area, which are the gas cap wells, and it will have a more pronounced effect there, and, of course, the oil production has already a relatively low rate there.

Q What I am getting at is this: With the wells further

West, at that time still classified as oil wells, they would derive practically no benefit from the storage of gas in the gas cap?

A Putting the gas back into the gas cap in itself is not a measure that one would take if one were trying to use that gas most effectively to recover oil from the down structure wells.

Q Thanks very much, Dr. Katz.

Q DR. BOOMER: Referring to that point, Dr. Katz, it is true that at present the down structure wells have pressures over 1000 pounds?

A That is right.

Q And that pressure decreases gradually across the field to a minimum from the gas cap?

A That is right. You are thinking particularly of the South end now?

Q Yes, thinking of the B.A. area. If the pressure rises through repressuring the gas cap, simultaneously the pressure is dropping in the oil area due to withdrawal. Have you any idea whether the pressure in the down structure oil wells will be comparable with the gas cap pressures at the time that the gas cap pressure is increased by repressuring the edge wells. Is there likely to be a dip in the pressure contour across the structure?

A It is quite possible that the oil wells, the last row down structure, will be at a higher pressure than the gas cap, when the wells up in the intermediate portion are at a lower pressure than the gas cap, so the

gas cap gas could migrate to some extent to the upper, the higher gas oil ratio oil wells, but would never get down to the oil wells along the border edge.

Q The down structure oil wells, in other words, will not be affected particularly by the storage gas?

A They will not be benefitted unless that pressure became less than the pressure in the gas cap. There is much less chance of that taking place than there is of the gas cap migrating to the upper portion of the oil area.

Q Suppose the repressuring program was carried out in such a way that the pressure gradient was maintained without that hypothetical dip that may develop, would that improve the situation as far as the oil wells were concerned?

A You mean that if the pressure gradient occurs, the higher pressure in the gas cap and a lower pressure in the down stream oil wells?

Q Yes? I mean if at all times there is a uniform gradient across the field, decreasing in the down structure and the gas cap steadily, or as you put the gas back into the structure, the gradient changes more or less regularly so that there is never a low pressure area to the gas cap from the down structure oil wells, would that benefit the oil wells?

A If the gradient completely reversed so that there was a high pressure in the gas cap, the next higher pressure in the upper - the next lower pressure in the upper oil wells and the next pressure in the down structure oil wells, then the oil wells would stand to gain by the amount of gas they would get by such a procedure.

MR.HARVIE: I have just a very few questions I would like to ask the witness, Mr.Chairmann but I was wondering if we might have a ten minute adjournment.

THE CHAIRMAN: We are sitting this afternoon, Mr. Harvie, and I will adjourn at twelve and come back at two o'clock. It is nearly twelve now.

MR.HARVIE: I was going to go over some points that have been dealt with by Dr. Katz with Mr. McCutcheon, and if we can adjourn now and start at two o'clock.

THE CHAirman: Does that suit everybody, two o'clock?

MR.CHAMBERS: There is one point I would like to bring up. We had a meeting, some of us, with regard to the agenda in the future, with the idea in mind of not keeping the gentlemen from outside of the city here longer than necessary. Now one of the main things we were talking about is the question as to whether we would be speaking to the matter of the valuation of the plants. Now I understand that the Board's witness, Mr. Biddison,has not yet made his valuation, or it might be some time before it is written. My witness in that regard is here and I was going to send him home.

THE CHAIRMAN: I don't think he is going to make a valuation.

MR.CHAMBERE: At least make an inspection.

THE CHAIRMAN: If he does anything he will be doing a critical analysis of valuations made by other

people.

MR.CHAMBERS: But I understand that he has not even been out to see the plants whatever, has not undertaken his work, whatever it is. Now I have a man here and frankly I intend to send him home, and I would like to have some idea of when he could come back.

THE CHAIRMAN: Well now, I will tell you how easy it is to tell youthat, Mr.Chambers. On Monday Mr. Steer said he would take about ten minutes to cross-examine Dr. Katz. Mr. Fenerty said he had about six questions. Between the two of them they took an hour and twenty-five minutes. So that is how easy it is for me to tell you when to bring your witness back.

MR. CHAMBERS: The only reason I am raising that is if I do not have them here on the very date needed I do not think I should be held accountable too strictly.

MR.STEER: I think you have me mixed up with the gentleman over there, sir.

THE CHAIRMAN: Of course, Mr.Chambers, we have to accommodate these men as much as possible. How did you revise the agenda, in what way did you make a revision?

MR. CHAMBERS: This is one that was tentatively done between the Counsel who talked to the various parties.

(Documents handed to the Commissioners and Counsel)

That is, of course, for the Board's consideration

and approval, but it might be worth while, I suggest, to speak to this matter pretty soon.

THE CHAIRMAN: I think we will, Mr. Chambers. All right, we will adjourn until two o'clock.

(The Hearing was then adjourned until 2 P.M.)

.....

14th March, 1945.
P.M. Session.

MR. BLANCHARD: Dr. Katz has just gone downstairs for his brief case. I notice there are two corrections that should be made in the transcript of the evidence given yesterday in volume 9, at page 584 in the last answer on the page: "A. Well I have gone over history of appeals." It should be "fields". Then on page 608, the top line, it should be "gasoline operator" and not "gas operator".

I have now received the 1943 Summary of Production sheets which I will have marked as an exhibit. (Exhibit now marked).

.....

DR. KATZ, RECALLED. Cross-examination by Mr. Harvie.

Q Dr. Katz, there has been considerable evidence given as to gas being re-pressured in various areas of the field. What is your view as to the gas that is being re-pressured being available at a later date?

A The gas that goes into the reservoir is essentially all available for production from the reservoir at one place or another at some future date.

Q Now in connection with the present basis of allowables, you are using what is known as the Brown Plan?

A That is right.

Q I understand from your evidence that you consider that if followed there is sufficient available reserves in the field to supply the market or the 12 billion feet, the average market of 12 billion feet a year for a period of some 26 years.

A That is right.

Q Do you think that can be done under the Brown Plan or will there be required at a later stage some changes or additions or alterations to that Plan?

A Well I believe that the allowable under the Brown Plan of 25 barrels of reservoir fluid per acre per day will probably have to be raised as time goes on in order to produce the gas required for the market.

Q Have you any further light to throw on that possibility or any other thought you have?

A Well the exact time that will come, of course, a person would not know. It would depend upon the conservation and the effects that it would have over the oil area. It would change the rates of production of oil wells as well as gas wells.

Q So that in principle, the Brown Plan you think could be followed for the entire life of the field, subject to changing some of the . . . . .

A As the field gets relatively close to abandonment the chances of one needing any kind of Plan or restrictions are not very great. Other fields when they approach the point of abandonment have no restrictions, That may not be true

of the field until we are getting very close to it, I do not know, but as a general rule that view holds.

Q When you say no restriction, you mean 100 per cent or is there some usual restriction?

A In many of the older fields of the country I have in mind places where proration is followed and they are allowed to produce at full capacity.

Q I have heard from time to time that it is maybe good field practice to restrict the flow of gas from gas wells to 25 per cent of the open flow. Is that a universally accepted view?

A That is the law in several States that they cannot produce more than 25 per cent of the open flow potential. Beyond that amount, if there is no wastage and it is used for heat, light and power, it can be produced.

Q Do you agree with that figure, reasonably closely?

A As far as the production of gas as gas is concerned, that would be quite in order but the question will arise when that gas area is within an oil area what is to be done. I do not believe gas allowable is necessarily followed. That applies primarily to gas from a gas field.

Q So far as the gas cap is concerned, you consider that good engineering practice as applied, we will say, to the gas cap in Turner Valley, up at least till the field is just on its last legs that the rule of not producing more than 25 per cent of the open flow is one that should be followed?

A If gas in the gas cap were to be of value in oil production, then from the standpoint of oil production of course the production of the gas cap gas is harming the oil field. As far as the gas cap itself is concerned, that rule would be all right, if you were not assuming that the gas cap assisted in the production of oil.

Q So that for the period so long as the matter of the production of oil is a factor in the field you consider there should be some restriction on the gas cap?

A That is right.

Q And you think possibly if that is cut that 25 per cent, or no more than 75 per cent produced, it would be a reasonable restriction? I am talking now as far as gas is concerned altogether and not with relation to the production of oil.

A If you are considering the gas area as part of the oil field, as I believe it is considered here, then this 25 per cent open flow you have mentioned is not necessarily the rule you should follow in the production of gas from that area. You would consider the gas from the standpoint of its relationship to the oil area.

Q And that is where the Brown Plan . . . . .

A That is the basis of the Brown Plan, that is right.

Q Then on the evidence we have of your estimates of supply for the Calgary market, which I will interpret as 12 billion feet a year, and assuming that the peak load of supply to the market at times of the year might run up to 90 or 100 million feet a day, do you con-

sider that if Calgary had no other source of supply for the full 26 year period until all the reserves out of the field are gone, that Turner Valley could supply the Calgary market.

A When you say whether it could or could not, one of the first and prime things that would come up would be the amount of compression you would be willing to put in. It would probably not be economical to purchase the compression required to have Turner Valley produce the peak load to the end. As to the physical possibility I am not sure but I think it might be physically possible even though it should not be economically possible to do it because of the compressors.

Q Have you any figure in mind as to the period of time we might be able to carry on and supply the entire Calgary market with 100 million feet maximum per day and 12 billion per year without getting into the realms of economics?

A I have not made a real study of that to be able to make any prediction, I do not believe.

Q Have you any rough idea? Have you thought of the matter at all?

A Well as you know I have read other people's reports and I am in general agreement with them. I do not know as I have anything further to add.

Q So to summarize what you have said, you think physically it might be possible to supply the entire Calgary market from that field for the 26 year period, if economics were not a factor?

A Yes.

Q And it is just a question of how soon economics would require some other formula or some other field or some other arrangement.

A That is so. It might take an unusual amount of compression that a person would not be willing to put in under normal circumstances.

Q Have you any thought in mind as to how soon it might be before some change would be necessary in the present plan?

A Well I would say that certainly at the end of 5 years. At the end of 5 years people will be taking a look at it and wondering if maybe there should not be some changes. Maybe before that. For the next 4 or 5 years it has a fairly good chance of continuing as it is.

Q For the next 4 or 5 years it looks like you could see that far ahead and see that the present suggested solution will answer the requirements?

A I think that is a fair statement.

Q Then we come to the end of 4 or 5 years and we find there are some difficulties arising and your suggestion is to change the Brown Plan by increasing the 25 barrels.

A I think that is a possibility, yes.

Q Are there any other changes you may think might assist at that time?

A I do not know that I can think of any.

Q That would be the chief one?

A Yes, that would be the chief one.

Q Doctor, you are familiar with a great many other fields where re-pressuring was tried out and I imagine you know some where you might say there is no market, just an operation within the whole field itself, other than where there is a market in those fields. In those fields is it, or any field, is it common or usual practice to adopt the net allowables rather than gross allowables? In other words credit back to what is drawn from there, from that area, the amount that is re-pressured?

A Yes, I think so. If you were producing oil and you say in terms of gas production from that area that the gas production should be credited with the amount produced minus the amount that was put back into the reservoir.

Q Do you think that would be applicable today as a fair basis of operating in Turner Valley as a whole?

A Well I think it should be given some consideration at a time when the plant equipment and so on was idle and could handle more gas.

Q At that stage you think possibly that might be a proper move to take?

A Yes. At least, to consider.

MR. HARVIE: There is just one further point, Mr. Chairman, that I am not quite clear on that I might clear up before Dr. Katz leaves the box. I do not know whether he will be through with cross examination when I sit down or not, but I understood from a remark you made to Mr. Steer. . .

THE CHAIRMAN: Take all the time you want, Mr. Harvie. The others did and you are entitled to do the same thing.

MR. HARVIE: I have sort of had a free ride getting information that possibly I would have asked for myself. I understood from the conversation that took place between Mr. Steer and yourself in connection with Dr. Katz' evidence, that we would be entitled to restrict any examination or cross examination of him now to the matter of reserves.

THE CHAIRMAN: Yes.

MR. HARVIE: And that possibly in his report on the field there are other viewpoints that he expresses that it is difficult to cross-examine on until more information is available. In talking the matter over, I understood you had assured Mr. Steer that those views would not be included in the report or we would be given an opportunity of cross-examining Dr. Katz on them.

THE CHAIRMAN: The position I think, Mr. Harvie, is this, that some of the opinions that are expressed by Dr. Katz under the heading: "Summary and Recommendations", I would not treat them as being evidence at all, upon which I can base a conclusion.

MR. HARVIE: Yes.

THE CHAIRMAN: In other words, so far as I am concerned at the moment, - and I do not know of anything else on which Dr. Katz is going to give evidence - but his evidence starts at the page

headed "Natural Gas Reserves and Considerations of gas gathering schemes in Turner Valley."

MR. HARVIE: I think that may be very true. On the other hand we were fortunate in having a man of Dr. Katz' experience in a great many other fields in the box and he possibly could be of great assistance in giving some views and expressions of opinion on these other matters. My whole point is this, may we expect that probably he will be recalled at a later date?

THE CHAIRMAN: I have not that in mind that he will be recalled. I do not have that in mind at all.

MR. HARVIE: Then with that in mind, I would like an opportunity of possibly just considering whether there are some other phases we would like to get his views on while he is here.

THE CHAIRMAN: Well I do not want to restrict you, Mr. Harvie. I just wonder what sort of a door you are going to open if you do that?

MR. HARVIE: Yes, that is just the trouble. I think he is peculiarly well qualified to give views on a lot of these other points. Mr. Chambers just suggested a procedure, I think, that happened once before where the Board got an expert or produced one such as Dr. Katz and was taking the position he takes at this inquiry so that he would possibly be recalled after the other experts' evidence is submitted, whether to give a summary or explanations and at that time we can decide whether we want to carry on with the

other matters or not.

MR. BLANCHARD: That is true, he will be recalled.

MR. HARVIE: So he will not be leaving today?

THE CHAIRMAN: No, that is quite true. He will be here while the other experts are giving their evidence.

MR. HARVIE: That is fine, thank you.

MR. BLANCHARD: That is at the end of this chapter of the agenda.

THE CHAIRMAN: Quite.

Q DR. BOOMER: Dr. Katz, I would like to have you return to one of the questions Mr. Harvie asked you on the subject of net withdrawals. If I understood you correctly, you said that it was a fair enough procedure to consider production from the gas cap area in terms of the net. Do you mean by that if we gave the Brown allowable on the gas cap, say in round figures 1 billion feet a year, and by re-pressuring 2 billion they should be allowed to take out 3 billion?

A I do not think that is what I had in mind. I have in mind more an oil field in which the restriction was based on their gas production and you are allowed a barrel of oil, we will say, for two or three thousand cubic feet of gas. If you take more gas than that they restrict you. But if the person who is flowing those wells would put into the ground a given quantity of gas they would compute his oil rate upon the net production of the gas and

that you are putting the gas back . . . . well I say that more with respect to an oil field probably than the gas cap.

Q Now suppose we deal with the gas cap. If the net production was counted as the allowable is it not true that the result would be there would be no storage?

A Yes.

Q There would be no gain.

A If you call net production there would be no storage, that is right because the gas is coming from another area, that is right.

(Go to page 730)

MR. HARVIE: May I ask a question on that point ?

THE CHAIRMAN: Certainly.

Q MR. HARVIE: Take the B. A. area, such as is a gas cap and the crude, how would you define that area, as a gas area or an oil area or an oil field ?

A You mean the whole area down there ?

Q Yes.

A Well we have the original gas cap and we have the oil area which has derived a gas cap on it and then the other oil area, there is the area that is producing the oil at a relatively low gas oil ratio.

Q So that it is a combination field ?

A Yes, I guess you might call it a combination.

Q Do you consider that repressuring in the gas cap will have any particular benefit to the production of oil in the marginal area first and then the B. A. area as a whole ?

A Well the plan of putting the gas back into the gas cap as such it surely would not be a complete plan or what you would call a repressuring of an oil field, - there are many other things to be considered in a plan, where a plan was made to be what you would call a repressuring project for the purpose of increasing the production of oil. When you repressure and put that gas back into the oil reservoir and hope to increase the oil production, it is common to unitize the oil rate and really to operate the reservoir in this case at the lowest gas oil ratio for oil production and the plan of putting gas back in the

gas cap could not be considered to be, make this project a repressuring project for oil production in the usual sense of the word.

Q I think I follow what you are saying but maybe I can ask my question in this way and it will throw more light on it; if we were agreed on this area, would you consider that there might be a possibility of improving the over-all production under good engineering practice by working on an allowable basis, in other words, if it ran along say twenty million cubic feet a day and that it might be possible to produce twenty-five million cubic feet a day, and as a result of it, have a more efficient over-all operation, leaving your facilities idle part of the time.

A Well if you said produce fifteen instead of ten or something like that, having facilities for twenty, why I can conceive of having sufficient use of your equipment in terms of trying to increase the oil production by putting the gas back into the reservoir for the purposes of increasing the oil, and then the extra gas that you had put back by running your plant at higher capacity, should have some chance of increasing the oil production and of course the gasoline that would accompany the gas.

Q It might have a benefit then ?

A Yes. Now when I say that I am thinking of the over-all. There will be some who will have a detrimental effect of course.

Q But throughout the whole area what would be your comment ?

A Well if you put more gas back into the oil portion of the reserve by such a procedure and if you do not harm the gas oil ratio it should be evident that the extra gas you put back, if it came out at a given gas oil ratio, should increase the oil production and of course the gasoline in the course of its circulation.

Q And that would be a benefit ?

A I believe anything that would help the oil production without being a detriment to anything else would be normally worth while.

MR. HARVIE: I think that answers my question.

MR. BLANCHARD: Dr. Katz, I have a few questions - -

MR. STEER: Before my learned friend proceeds there are one or two questions I would like to ask Dr. Katz.

THE CHAIRMAN: Yes.

CROSS-EXAMINATION BY MR. STEER.

Q The unit production which you were discussing, Dr. Katz, do you know of any place where that is put into effect ?

A Well I have in the back of my mind reading about it, but I cannot put my finger on the place.

Q You have no experience of it ?

A Well there are not many places that are prorated on the basis of gas production but I do know that in the operation of a field where the proration is on the basis of oil production, that the gas that is put back into the reservoir is normally thought of as being

credited to the operator that puts it back.

Q But you cannot name any field where that is done ?

A I cannot at the moment say that I can.

Q If you would care to investigate it and let me know I would appreciate that ?

A I can.

Q Would you look at your supplementary report on pages 3 and 4; in the B. A. gas cap on page 3 you give the pressure there of 2320 pounds; in the North Royalite gas cap area on page 4 you give a pressure of 2360 pounds; but the report does not give the pressure which you utilize with respect to the G. O. P. and South Royalite gas cap areas, have you that figure ?

A I think that figure was the same as that which was used in the July 1st report.

Q And what was that ?

A Just a moment, 2300 pounds at minus 1500 feet.

Q Yes. Now then in your calculations I think you told us that you used the original bottom hole pressure of 2250 pounds ?

A At a given point, I believe that is minus 950 feet.

Q And the difference between the average pressures in these three areas which I am speaking of and your 2250 pounds would be accounted for you think by the difference in depth, is that it ?

A Average depth, yes.

Q The initial pressure is what you are talking about in these three figures that I have spoken of, is it ?

A I am sorry.

Q Is it the initial pressure ?

Dr. D. L. Katz,
Cross-Examined by Mr. Steer.

A Oh, in these figures we have just spoken of.

Q Yes.

A Yes, the original pressures of the reservoir, the initial pressures of the reservoir.

Q Then that never changes ?

A Well the initial or original reservoir pressure is the pressure at the time of the discovery of the field.

Q That is so ?

A That is what the word means as I understand it and it may have changed or it may not have changed, depending upon the production having been taken from that area or not, up to the present time.

Q Yes. Then as production takes place I take it that that initial pressure is going to decrease ?

A The pressure is going to decrease but the initial pressure still remains what it was.

Q Quite so. Then I find it difficult to understand how we are going to have any computations which are made on any pressure which is above 2250 pounds ?

A Well I believe we have something here that will clarify that if Mr. Blanchard would like to put it in at this time. I have tried to explain it two or three times and I have a chart prepared which I think will explain that, if you would like to present it.

Q I would like to have that produced. Perhaps you can explain it, using your chart as you see fit.

MR. STEER: I would be satisfied, Mr. Chairman, if Mr. Blanchard will undertake to have

the witness explain that when he examines him.

(Charts here produced by Mr. Blanchard)

THE CHAIRMAN: Mr. Blanchard, you are going to lead that evidence, are you ?

MR. BLANCHARD: I was going to lead it but perhaps my learned friend Mr. Steer could do it much more intelligently than I can.

MR. STEER: Don't worry about that.

MR. BLANCHARD: And I say that in all good faith, sir.

THE CHAIRMAN: Then if you will leave that, Mr. Steer, and go on to something else.

MR. STEER: I will leave it.

THE CHAIRMAN: And then you can re-cross-examine on it later.

MR. STEER: Yes.

Q MR. STEER: Now there are one or two other questions, Dr. Katz, that I intended to ask you before, - the first is when you came to make this computation of these reserves did you consider the use of any other method than the material balance method ?

A Are you speaking of the gas cap or the oil area ?

Q Both.

A Yes, I considered other possibilities.

Q What other methods did you consider using ?

A Well I, of course in the beginning always enquire from the geological data where it can be available as to the position of the proposition and I learned

that that was not available and the only other method which you would consider would be the decline curve but I had, we had recently come through the experience of proration and at the time that proration came in the decline curve as such, had gone by the board, people were not using them much and it was only as we had a uniform plan of withdrawal in recent years under the Brown plan that you could consider using them.

Q And this material balance method as I understand it has been used for only comparatively few years in the computation of such reserves ?

A Relative to oil areas, yes, I would say from 1933. At the time I was developing the method which I use, I enquired of many of the leading engineers at that time and I found no one who was familiar with it although an article had been published in 1930 which had explained the principle but it explained it in mathematics and most people had not understood it.

Q I understand that you are the man that principally used this method ?

A I would not say "principally used it". There have been other people who have used it. Mr. Cartier and the Phillips Petroleum Company used it in a field in Arkansas, where they had stone, the thickness or porosity method are within two or three percent in that particular case. The core of all wells was taken and all information and on everything it was shown the two methods to be practically the same.

Q I am not sure whether I understood the evidence but I understood you to say you used this method in

Turner Valley and then I think you said Oklahoma City ?

A Oh, I have used the method in other reservoirs. When I was employed with Phillips, and I used the method with the Department of Conservation in the State of Michigan and of course I used it in my teaching. Of course I do not recall that I applied it to any problems at that time.

Q Then one further question which perhaps I should have asked before, you made computations of the reserves in the gas cap and in the crude oil area ?

A That is right.

Q And are you prepared to say in which of the figures, in which of your estimates, you have the greater confidence as to its accuracy ?

A I feel I have the greater confidence in the gas cap probably.

MR. STEER: Yes. That is all.

RE-EXAMINATION BY MR. BLANCHARD.

Q Dr. Katz, following my friend's question, would you please explain to the Board your method of arriving at the original reserve pressure in the gas cap ?

A Well this chart which shows the Turner Valley limestone, the pressures in pound per square inch against elevation in feet, was the basis of my arriving at reservoir pressures initially in the field.

MR. BLANCHARD: Possibly this had better be put in as an Exhibit now.

CHART PREPARED BY DR. KATZ
HERE MARKED AS EXHIBIT 36.

Q MR. BLANCHARD: This chart was prepared to explain the method, Doctor ?

A Yes, I might say the report of Professor Brown and myself in 1939, which appears here as an Exhibit, has a similar chart in it. The records of early pressures in the wells in the gas cap were surveyed and considered, primarily in terms of having a well which was some distance from earlier production and which well had a measurement of pressure-and still-are at the well head,-and the pressure, the highest pressure which was measured and that it so happened that well had a measurement of this pressure earlier in its life, was the Merlin No. 1. I think it was 1885 pounds at some 4300, 4290 feet, was its elevation at the well head. If you take that pressure and the properties of the gas and compute the gradient of pressure as you go down the well you will follow the curve which I have drawn of 7.34 pounds per hundred feet on the average and I have drawn that curve to minus 2200 feet, which in my report in 1939, at that time I made studies of the gas-oil contact, this minus at 2200 represented what I felt was the original gas-oil contact. At that point the gradients of pressure with depth would change from a gas gradient to a liquid gradient; also at that time we had the build-up pressure on the Home-Millarville No. 2 well shortly after it was drilled in, this well being a considerable distance from prior production. If you connect the point, the minus 2200 feet that you have from the gas

gradient with the Home-Millarville No. 2 well you should have the liquid gradient in accord with the density of the oil in the reservoir.

This oil or liquid gradient computed to be 33.1 pounds per hundred feet of oil, which gradient is in accord with the properties of the oil in this reservoir and in accord with the measurements of the oil density I believe in the well.

In reconsidering the estimates of this pressure I enquired if there were any wells which had been drilled some distance from earlier production with a good build up pressure on it and I was informed from the Conservation Board's records that the Atlas and British Dominion No. 2 was such a well and I said "Will you give me the depth and I will tell you what the pressure should be" and we plotted the point on here and you will see this, my original, I think it was some 25 pounds like it looked maybe like 30 to 35 pounds low, from the original pressure predicted from this gradient.

Q Well that is you predicted the pressure of the Atlas and British Dominion well based on the factors as you have mentioned ?

A That is right.

Q Before you knew its depth ?

A Well you predict the pressure from its depth.

Q Yes, but I understood you to say you could tell me the depth of the well if you were told what the pressure is.

Dr. D. L. Katz,
Re-ex. by Mr. Blanchard.

A Well from the curve I would read 3100 pounds we will say and the pressure given to me was 2960 I believe.

(Go to page 741)

Q Oh yes. You told them the depth of it?

A No, I told them the pressure from the depth.

Q You told them the pressure from the depth?

A Yes, that is right.

Q Now, Mr.Steer yesterday took up with you the question of the cubic feet of pore space as calculated by you, taking an initial reservoir pressure of 2250 pounds down to your 1944 pressure, I think it was, of 536 pounds, and you calculated the cubic feet of pore space in the gas cap at 6.87 billion cubic feet of pore space?

A That is right.

Q That was calculated over a period going back to the earliest history of the field?

A That is right. The initial stage, yes.

Q Your initial calculated resevoir pressure?

A That is right.

Q Now then, I think Mr. Steer then asked you to calculate the pore space based on data in more recent years, taking the drop in pressure between 1934 and1943?

A That is right.

Q Over which period there was a certain drop in pressure, and a certain production during that period ?

A That is right.

Q And from that I think you had to agree with him that simply taking that particular period as your period for calculating pore space, you would have 11.9 billion cubic feet of pore space?

A That is correct.

Q Now then, would you please explain how you account for that disagreement in these figures?

A Well, there are probably three things that should be mentioned. In the first place you are taking a difference between relatively large numbers which, even though they may be substantially correct in themselves, with a given error, the difference between those numbers may become considerable in error. The second thing that probably should be mentioned is that the pressures in 1934 were known not to represent the reservoir pressure as well as in 1943, but I have made no particular corrections about that becaus I did not intend them to give the final volume for my reservoir. And the third thing is that gas migration to the extent that it did take place would cause a considerable error in the result computed by that procedure. In fact, after going over it again, I had already made the computation which I was asked to make here, but I went over and made several of them. You can, of course, make a difference in the computation values in a computation of the kind I was requested to make.

Q And the computations are different in each case?

A Yes, the computations are different in each case. 1938 to 1943 comes to 14.8 billion; 1940 to 1943 gives 1).9 billion; 1934 to 1938 gives 11.1 billion; but 1938 to 1940 gives 26.3 billion. AndI do not believe that anyone would say that the error in the gas measurements which would have to be postulated, in order to make these figures correct, could be true. It would mean at least some three trillion

feet of gas had been produced from this field and has not been recorded.

Q Instead of approximately 11 billion cubic feet, no, 1100 billion cubit feet that are shown by the Petroleum and Natural Gas Board's exhibits as to production to date, you would add, if those were a correct factor, 26.3?

A A reserve content of pore space.

Q Then instead of 1100 million the production would have to have been 3 trillion to date?

A Yes, or even more than that.

Q Or even more than that?

A Yes.

Q The Petroleum and Natural Gas Board would have been out a very large amount in their production to date then ?

A Yes.

Q If the pore space is as indicated by the datataken from 1938 to 1940 only?

A Yes, or of any other of the other of these close intervals.

Q Of any of them?

A Yes.

Q DR. BOOMER: What is the difference in the pressure used in that between 1938 and 1940?

A I think it is 23 pounds.

Q What are the pressures?

MR.BLANCHARD: I think it is 621 down to 536, is it not?

A Yes, 621.

MR.BLANCHARD: Down to 598, I mean.

A In 1938 there was 621, in 1940 was 598, which gives a 23 pound drop in bottom hole pressure.

Q What probable error do the pressures involve?

A Well certainly five or ten pounds would be good, and there are lower ones in the earlier dates, the 1938 figure, I think, is a matter of ten or fifteen or twenty pounds error between the bottom hole pressure and the average of the reservoir, and that would not be out of line.

Q What I would like to have you illustrate is this, Dr. Katz, apart from migration altogether, that an error in initial pressure as calculated by you, initial pressure of 2250 pounds, that there an error of let us say 100 pounds would relatively be a small error but an error of say 5 pounds, calculated on the 1943 pressure, would be much greater?

A Yes five pounds out of 23 would be more than 100 out of some 1700.

Q Yes. So that the relative error, if a small error in the pressure over a short period, a small error, will give you a very much greater error, than a large error taking the long period from the beginning of the field down to the present time?

A That is right.

Q Now, Mr.Chambers discussed with you another matter, and spent some time with you over an assumption relating to the computation in Table 4, that is, for the B.A. Oil area, in which you placed in your report that that was assumed, the 47 million barrels oil production?

A Yes sir.

Q And you endeavoured to tell Mr. Chambers that that had very very little effect upon your gas reserve computation?

A That is right.

Q Now for what purposes do you make any assumption at all about the barrels of oil production?

A To find the gas which remains in the reservoir at the 250 pounds pressure.

Q That is the gas that is lost?

A The gas which we do not include as available reserve.

Q The gas which you do not include as available reserve?

A Yes, but it was part of the original oil in the reservoir. It is necessary to know the volume of the gas cap or the gas phase in the oil area at the time of depletion or abandonment, which was assumed as 250 pounds, because if you take the total quantity of gas originally present, and you subtract the quantity of gas which has been produced, and then you subtract the quantity of gas which is in the gas cap, in the reservoir at the end, and you subtract the quantity of gas, of course, which is in the oil which remains in the reservoir at the final pressure, and in making the estimate of the volume of the gas cap and the quantity of gas which remains in it, it was necessary to find the volume of that gas phase and, therefore, I had to assume some quantity of oil.

Q Now I think it would be well to illustrate just what difference it would make in your computation of gas reserves if you adopt Mr. Chambers' computation of the

number of barrels per 1 pound pressure drop and let us follow his figures down to 250 pounds and see how much difference, how much difference it makes in your computation on the material balance method in the gas reserves. Now we have had that there was 18 million, 18.5 million I should say, barrels of oil produced down to a pressure of 889 pounds. I would like you to correct me if I am wrong.

MR CHAMBERS: 18.5?

MR. BLANCHARD: 18.5.

MR. CHAMBERS: 18.15 wasn't it?

MR. BLANCHARD: Yes, 18.15. Then it was computed that there was 9808?

MR. CHAMBERS: 80.

MR.BLANCHARD: Yes, I beg your pardon, 80, 9880 barrels for each drop of 1 pound in pressure, that is, down to the pressure of 889 pounds which was the 1944 pressure. Then to produce that down to 250 pounds, which is your abandonment figure, that left 359.

MR. CHAMBERS: 639.

MR. BLANCHARD: Five hundred.....

MR. CHAMBERS: 639.

MR.BLANCHARD: Yes, 639. That is, 639 pounds that the reservoir pressure has still to drop. And if we accept Mr. Chambers' figures of 9880 barrels per 1 pound drop in pressure, that will mean that there will be produced on his basis, cepting his basis of computation, that would mean that there would be approximately 23.5 or let us say 24 millions barrels

of oil produced down to 250 pounds pressure. You follow me?

A Yes sir.

Q Now then, let us accept this figure as a proper assumption, and will you tell the Board what difference it would make in your total gas reserves? First, how much less gas would you have left in the reservoir for 250 pounds abandonment pressure, and, conversely, how much will it increase your reserve?

A You would have about a 1.3 billion cubic feet of gas in the B. A. Oil area less in the reservoir at the 250 pounds with that assumption of oil production over what I have had assumed, and consequently would increase the reserve from the oil area, the British American unit, 1.3 billion cubic feet.

Q So that if you accept Mr. Chambers' figures, it will mean that you are low in your estimate by 1.3 billion cubic feet of gas in the B.A. Oil area?

A That is right.

Q Allright. I just wanted that as an illustration of how much importance is to be attached to this assumed figure of 47 million barrels of oil.

mr. CHAMBERS: I would like to get that figure. the 28.85 is changed to 23 is it?

MR.BLANCHARD: I beg your pardon?

MR. CHAMBERS: That figure of 28.85 million barrels is changed to 23 millions?

MR.BLANCHARD: Let us see. My multiplication might be wrong. I multiplied it. I will just check it.

MR.STEER: Make him use the slide rule.

Dr. D. L. Katz,
Re.Ed. by Mr. Blanchard.

MR. CHAMBERS: Did I understand that that resulted in 23 million?

MR.BLANCHard: 1.3 billion difference in the gas left in the reservoir. That is less gas left in the reservoir and that much more gas left to be recovered from the gas cap.

MR. CHAMBERS: I thought he gave you a figure as to the difference in the oil that would come out. I might be wrong but that is my understanding.

MR.BLANCHARD: No, gas.

MR. CHAMBERS: Did he not mention a figure of twenty something?

MR. ARNOLD: You gave a figure of 24 million barrels of oil.

MR.BLANCHARD: That is right.

MR. ARNOLD: 639 times 9880 does not make 24 million.

A WITNESS: Yes, but that is added to the other. 47 was the total production.

Q MR.BLANCHard: And you get what production now?

A 24, I believe is substantially correct.

Q MR.BLANCHARD: 24?

A Yes.

Q Perhaps I gave the wrong figure, but that is the difference it will make if you accept Mr. Chambers' figures, there will be produced 24 million barrels between now and abandonment.

A That is the total production.

Q That is the total?

A That is the total.

Dr. D. L. Katz,
Re.Ex. by Mr. Blanchard.

Q I am sorry. That is where I went wrong. All right. And that will make the difference as you say of 1.3 billion cubic feet in your estimate?

A That is right.

Q All right. I have got it straightened out in my mind now. At last it is straightened out.

(Go to page 750).

Q Mr. Steer discussed with you something about the abandonment of oil wells at a bottom hole pressure of 600 pounds and he asked you today or put it to you that if evidence is given that oil wells will be abandoned at 600 pounds, does that make any difference in your computations and you said of course it did.

A Yes.

Q When you speak of 250 pounds abandonment reservoir pressure in the oil area, do you expect that all wells will be produced down to 250 pounds?

A No, sir. Part of them will be produced probably lower and part of them probably higher.

Q In other words, some of them will have to be abandoned at a much higher pressure?

A That is right.

Q But it is your judgment on the average it will produce the field down to 250 pounds?

A That is right.

Q Bottom hole pressure. Do you know of any oil field that has been abandoned where the pressure is 600 pounds, bottom hole pressure?

A I do not know of any well that has been abandoned at 600 pounds.

Q Do you know of any that has been abandoned at 250 pounds bottom hole pressure?

A Well I probably do not know of any exactly because if the pressure were taken as 250 pounds in an individual field and had been abandoned, they would be producing it. But that is giving some safety

to the time when oil production and gas production will be low and that 250 pounds is set as having to do with the gas when all but that is produced might not be as available as at higher pressures and costing a lot more because of the particular conditions at which it will be produced.

Q Mr. Fenerty discussed with you the matter of the re-cycling. Perhaps you covered that this morning. That is from the gas cap. As the pressure in the gas cap comes above that in the oil area that there will be a constant re-cycling of the gas through the oil wells. I think he suggested perhaps it would go through the oil wells five or six or seven times. What have you to say about that?

A Well the quantity of gas which migrates out of the gas cap, as I think I have said, is hard to estimate, but the quantity certainly cannot be several times the quantity of the gas to be produced from the gas cap or the oil areas. So that you saying it is going to cycle must be very specific concerning a few cubic feet of gas and cannot be said concerning the entire quantity produced in any sense of the word.

Q I think you have already stated that the plan of conservation here is not one for re-pressuring the oil area and that different methods and different considerations would have to apply if it were for the purpose of increasing oil production.

A Yes, if its primary purpose was the increasing of oil production you would simply put it in the gas

cap and oil and everything else go on as is.

Q It would be true that a large migration of gas from the gas cap would likely spoil wells as oil wells themselves to some extent. That it might benefit some that are further away from the gas cap, would that be correct?

A Well I would not say to that extent but I do feel that gas going back to the gas cap will be of some benefit to oil production. That is over-all benefit and that is very difficult to measure of course. But along with benefit will be some loss, some wells will not benefit relative to their ability to produce oil.

Q They will become gas wells rather than oil wells?

A That is right.

Q Now is there any other matter that you have been cross examined on that you feel you would like to elaborate on further, Dr. Katz, at this time?

A I do not recall anything.

Q Very good.

RE-CROSS-EXAMINATION OF SAME WITNESS BY MR. STEER

Q I am not sure, Dr. Katz, whether it is my ignorance that causes this difficulty and I am not enlightened at all by this graph. What strikes me about it is this that in your 1944 report with respect to the British American gas cap, you use these figures, 2250 pounds and 120°F at average depths that is right?

A That is right.

Q Now when you come to put in your supplementary report you use, as you say, the original conditions in the reservoir re-valuated as 160°F and 2320 pounds per square inch gauge at an average depth of 1650 feet.

A That is right.

Q You make the computation in respect of your 1944 report on one basis and then when you come to make your other report 9 months later you put it on an entirely different basis. Now why?

A Well I understand your question now. I do not know myself. In checking it over, I do not know how I arrived at the 120° and the pressure I had used. I do not know whether it was an error or what and that is the reason why I re-evaluated. I mean all these calculations in my supplementary report were independent calculations from the original and of course I went through the procedure and I thought I was following that through but apparently there was an error in the first report.

Q In the light of your answer, you sympathize with my lack of understanding?

A Yes, sir.

Q DR. BOOMER: That error appeared in your 1939 report. Is that not where it originated?

A It may have. I do not know. It is a relatively small item and it had very little to do with the reserves because the temperature offsets the pressure, apparently.

Q MR. STEER: Now then, I am interested also in these computations that you gave my learned friend about my examination from 1934 to 1943 and I call attention to your evidence in which you said that it could be, of course, any two dates. You re-iterated that statement to me yesterday. That is correct is it not? You can for your method use any two dates?

A Yes, but I expect a man to use some judgment in the two dates he is going to take.

Q I suppose. I think I even suggested to you yesterday that you could take a couple of dates pretty close together and you were not very emphatic in your denial of that proposition.

A That is right.

Q Now then, I would like you to give us those figures again if you will, because I did not get them all. We were talking about 11.9 billion feet of pore space were we not?

A Yes.

Q That is the result you and I got.

A That is right.

Q You told us that you had made computations with respect to other years and you got other figures. Will you just mention those figures to me?

A I am sorry, I have a whole group of them here but I have forgotten the ones I picked out, Maybe I could give you a series of them.

Q Yes, if you will.

MR. BLANCHARD: I was going to suggest that

this had better be put in as an exhibit.

MR. STEER: If Dr. Katz will put it in as an exhibit and I have an opportunity of questioning him on it, that is perhaps as good a thing as can be done. Does that meet with the approval of the Board?

THE CHAIRMAN: Yes.

STATEMENT OF PORE SPACE CALCULATIONS IS NOW MARKED EXHIBIT 37.

A Could I have an opportunity of preparing it with the proper titles and so on?

THE CHAIRMAN: Yes, do you wish it to go in the record now?

MR. STEER: I can ask my questions from that statement and they can be put in, yes sir.

Q I understand, Dr. Katz, that all these calculations were made by the same method.

A That is right.

Q We went over 1934 and 1943 together and we got what you have here, 11.86 or 11.9. That is what we had yesterday.

A That is right.

Q Then you tell me you will take 1936 to 1943, that is a period of 7 years and you get 13.08.

A That is right.

Q In a period of 7 years. Then you take a period of 5 years, 1938 to 1943 and you get 14.8.

A That is right.

Q Then you take a period of 4 years, 1939 to 1943 and you get 12.32.

A Yes.

Q I take it the proposition is that the closer the two years are taken together the larger the error.

A Yes. That is not necessarily but it could be because then if there were an error in opposite directions in the two numbers you are subtracting they magnify the error to a large extent in the numbers.

Q That is what I understood was the difficulty about taking 1934 and 1943, you did not like them to be so close together, is that right?

A Well that is from that standpoint it is right. The difficulty in taking 1934 to 1943 is that the pressure that you assumed was the average pressure in 1934 as being the average of bottom hole pressure is probably not too good. It would not have to be a great error in pressure there. A fair amount, but it would not be a tremendous error in pressure there that would account for that difference.

Q Then we come to 1940 and 1943, that is 4 years apart, and you get 10.92.

A Yes.

Q And 1941 to 1943 only two years apart you have 9.05.

A Yes.

Q Frankly, I would expect the 9.05 to be something more than 11.9.

A Not necessarily.

Q Not necessarily?

A No.

Q You engineers allow lots of scope for error I take it.

A If you will proceed with the method as I have done, it will become evident to you I am subtracting 38.8 from 41.2 and even with the slide rule you will make a difference of .1 off, there might be a 20 Per cent error even from the slide rule alone.

Q I can perhaps accomplish my object if I said to you that taking all these examples along with your original example, you get results which vary on this sheet from 26.3 down to 9.05.

A That is right.

Q That is right.

A Yes.

Q That is all, thanks.

Q THE CHAIRMAN: Dr. Katz, to a layman that might seem a tremendous variation. Can you tell us anything else that will clear up our minds on it?

A Well, I can give you an explanation for one of these numbers that would show you how a minor variation in the information would account for it and bring them all back to the original values. Maybe that would clarify it.

Q Could you do that?

A For example, if you will take 1938 to 1943, the value which is 13.8 billion cubic feet of pore space, it could be the result - the difference between that and the 16.87 which I got from the initial date could be the result of two things.

First, that the pressure in 1938 might have been too high or could have been too low when I used the bottom hole pressure from the gas well because up to that point they had been producing at a fairly high rate. You could assume that gas migration had taken place into the gas cap or you could assume a combination and I have made the three assumptions to show what magnitude of error could have caused this vast discrepancy between 6.87 and 14.8. You assume it is all due to migration and it would mean that 53 billion cubic feet of gas came into the reservoir and then everything would be in accord. Or you can assume it was all due to the 1938 pressure and in that case you would assume that the pressure, you would have to assume that the pressure in 1938 was 100 pounds too low for the entire gas cap. If you make a combination and assume that 25 billion cubic feet of gas migrated into the reservoir, you would then find that your pressure would have been 52.8 pounds too low in 1938. I believe these latter two assumptions are within the realm of what we believe occurred in the reservoir and gave an adequate explanation for these vast discrepancies of pore space as computed by these short increments of time as compared to the over-all period.

MR. STEER: And these errors you are talking about now, as I understand it, could creep into all your calculations?

A No, just to those people who are not careful how they make them.

Q You made mine. I did not make it.

A And I think I gave you those two explanations of the reason I did not use that method at the time.

Q DR. BOOMER: Dr. Katz, I would like to follow up some remarks that Mr. Blanchard made to you. Speaking of the abandonment of a well, an oil well, at 250 pounds, is that common practice in your experience outside of Turner Valley?

A No, I would say that all wells are not necessarily abandoned at 250 pounds and would normally produce at much lower pressures.

Q Even though there were 7000, 8000 or 9000 feet of depth?

A I do not know as I have had experience of wells lower than that in pressure at that depth. I have had experience of wells at depths of say 6500 feet where the pressure would be much less than that and they were still producing.

Q Considering a gas well, do you think a gas well will be abandoned at 100 lbs. bottom hole pressure?

A Not necessarily, no.
They could still produce substantial quantities of gas. If the gas had a value that would pay for getting it out, I think you would produce it.

Q The cost of getting it to market would be compression costs rather than production costs.

A Primarily yes, compression costs.

Q How about liquid loading in a gas well? Do you

know in your experience of any measures that could be taken to handle liquid loading in a gas well?

A I know it is a constant problem in many gas fields and the problem even relates to water coming into a well. I am not particularly familiar with it in detail. I have seen discussions of siphons, as they are called, for removing liquid in the wells. I know it is not an unsurmountable problem.

(Go to page 761.)

Q One other question and it may be unfair - ?

A It may be outside my field of research.

Q Have you any opinion as to the degree of saturation of gas reproduced from the formation after repressuring?

A You are referring to the gas cap?

Q Yes.

A Well I have not made a detailed study of it but I think a person could, if he had an analysis early in the life of the field, could determine the quantity of the liquid in the reservoir and this quantity, I feel further, from general considerations as to the amounts of gas which are comtemplated as going back into it, there is plenty of liquid there to saturate it with gasoline particularly if there is given sufficient time and space for it to travel the distance it has to travel.

Q Have you any idea as to the time that would be required?

A Well I do not know of any case but of course it is possible to put gas in one well and to produce it in an off-set in quite substantial quantities and have it come out dry and that is what I had in mind by "Time and Space". But I think under normal methods of production, that it will become substantially saturated at the pressures.

THE CHAIRMAN: Anything further, alright, thank you, Doctor.

MR. BLANCHARD: I wish to call Mr. F. K. Beach.

FLOYD KELLOGG BEACH having been first duly sworn examined by Mr. Blanchard testified as follows:

Q Mr. Beach, you are an official of the Petroleum, or an employee of the Petroleum and Natural Gas Board, The Natural Conservation Board of the Province?

A That is right.

Q How long have you been with the Board?

A Well I was transferred from the Depta of Lands and Mines to the Board in 1941; Prior to that I was with the Petroleum and Natural Gas Division of the Dept. of Lands and Mines of the Province, since the natural resources were taken over by the Province and the actual transfer at that time from the Dominion Government, with which I served, was in 1931.

Q Prior to that time you had been with the Dominion Department?

A I had been with the Dominion Supervisory Engineers since 1927.

Q And you are a registered engineer?

A I am.

Q What particular branch of engineering?

A Well I am actually registered as a civil engineer but as you can see since 1927 I have been intimately associated with petroleum and natural gas.

Q Ever since 1927?

A That is right.

Q And in 1927, at which time you were employed by the Dominion Government, you came out to Turner Valley?

A At that time I went into the office of the Supervising Mining Engineer in Calgary as an office engineer but I have been back and forth to Turner Valley and in that way acquainted with it, and acquainted with much which has gone on.

Q Now then we have exhibit 28, which is a historical summary of the gas and oil production?

A Which is that, is that this book here?

Q Yes? 1942?

A I have brought this along, my own personal copy for reference.

Q You have had something to do and a very great deal to do, if not everything, to do in the preparation of that?

A Very largely.

Q That is your work?

A That is very largely my work.

Q Very largely your work. Now when did you first, you, first start to compile records of production in Turner Valley?

A In 1927.

Q And at that time was any record of production of gas kept by any of the producers?

A In order to answer that it might be well for me to mention, and I am referring again to personal notes, The Honoreble Charles Stewart, Minister of the Interior of the Dominion Government, under date of October 1926 issued regulations requiring operaters of oil and gas wells to make reports of production and up until the time I went into that office none had been rendered, I went in there really to attempt to enforce that to

some extent and starting late in 1927 we began to get some reports of gas.

Q There were I believe reports of all the naphtha production?

A None had been collected until that time.

Q I see?

A But I, at that time, when we started getting regular reports, I made a point of attempting to collect as much information as possible of what had gone before.

Q Yes. Now then who was the principal producer in the field at that time?

A At that time Royalite was the large producer.

Q And did you make enquiries of Royalite as to what production figures they had kept up to that time?

A I made some enquiry and I did not get very far at that time but since then I have had very good co-operation from them and although some of the early figures from Royalite may have been sketchy, I got the best information that there was available.

Q From Royalite?

A From Royalite.

Q And that went back to their commencement of their operation in the field?

A Yes, and I might qualify that so that you can understand the meaning of some things that I have put into this exhibit here, Royalite started delivering gas to the Gas Company shortly after Royalite 4 was put under control and in operation and all the gas that they delivered to the Gas Company was metered.

Q That was from 1924 on?

A No, it would be sometime in 1925. Do not ask me to quote an exact date, it may have been late in 1925 but from sometime in 1925 the gas was metered but other wells were not metered. Other Wells. Now Royalite, having a staff, an engineering staff who wanted to know what their business was, I understand made periodic measurements of the flow of gas from their wells. They were the only party with a well that was delivering gas to a purchaser.

Q How many other wells were there in the Valley, in 1937 when you first came here, besides Royalite owned wells, Royalite owned or operated wells?

A Turning to pages 18 and 19 I think it is in this report you will find there is the 1927, Illinois Alberta was producing, one at least of the McLeod wells, Royalite 4, Royalite 6 and Vulcan 1, that makes possibly five or six wells were producing in 1927.

Q Now is that all the wells that had been producing, is that cummulative, were there other wells which had been producing prior to that and which had been abandoned?

A No, that includes all.

Q So that is all the wells we are concerned with up to 1927 when you went there for the purpose of trying to get accurate records of production up to that time?

A That is right.

Q And of those wells how many were not owned by Royalite or operated by Royalite?

A Two or three, three, The McLeod, The Illinois Alberta and the Vulcan.

Q Yes, three, and you say that Royalite furnished you later on with all such records as they had, on the production?

A That is right.

Q And that their production from 1925 on was metered, is that correct?

A no, just the gas that was sold to the gas company so far as I know, I do not know that they metered anything else.

Q Alright. Now then up to or perhaps I had better go on with what you did from there on; Now then did you yourself start to take measurements a little later?

A No, I did not myself take any particular measurements.

Q Well were measurement taken under your direction?

A Some measurements were taken yes.

Q When was that started?

A You are asking me now to give something from memory and as nearly as I can be sure it was sometime in 1930 before any systematic measurements were made of wells outside of the Royalite Organization; At that time the practice which Royalite had started was extended to the other wells, namely, of tapping the flow lines to the flare and inserting a Pitot Tube with a double tap, which enabled you to measure the pressure as well as the differential by water or mercury and a snap reading, - and when I say a snap reading I mean an instantaneous reading of just what is happening during the time you are observing the instrument, was taken and from about 1930, sometime

in 1930 and I cannot give you the date within a year, there was a measurement made about once a month, sometimes oftener, seldom less, at every well in the field, starting in October of 1933 after some delays in putting the order into effect requiring all operators to measure their gas, we at least got the meters actually and physically in place and metering started as I say in October 1933 and at the time that metering started, we had plotted the flow of gas, and the gas oil ratios, prior to the metering and subsequently there was no very noticeable jump.

Q I see?

A So we felt --

Q You had drawn a curve?

A We had, yes, we had drawn a curve and there is no dislocation of the curve at the time the metering started so that we had not been very badly off in our estimate where we had something to go on, prior to 1930 when this went into effect.

Q Just a moment, what you mean is since, from the time you started the Pitot Tube?

A That is right.

Q The examinations monthly of all wells?

A Yes.

Q Up to the time that the wells became actually metered, all wells, that if you drew a curve showing the gas production, there was no jog in the curve?

A That is right.

Q It was a smooth curve?

A That is right.

Q Indicating you say that the results you got, the monthly measurements with the Pitot Tube were fairly accurate?

A They gave us a fair indication of what was happening, yes.

Q A fair indication, yes; That takes us back then to 1930 or from 1930 on, as having had really substantial evidence to go on?

A Something to substantiate what was happening.

Q All right. Now I interrupted you?

A I was going to tell you prior to that we have had to make, I have put it down in this book as "Guesses". Now if we call this "Guesses" it depends upon what you mean by "Guesses", the order of accuracy is low.

Q You are referring now to page 15 of the exhibit?

A Page 15 is right and if I may call your attention to page 15, production from gas wells, 1924, one million two hundred and seventy-five thousand, - there are three ciphers at the end; that might be taken to mean as it is drawn that it was one million nearer to one million three hundred thousand than it was to one million two and a half, or one million three hundred thousand, the way that is written might mean that, whereas to come to 1926, six million seven hundred and eighty-eight thousand, with three ciphers, that would normally mean that it was nearer to that figure than the six million seven hundred and eighty-nine thousand or six million seven hundred and eighty-seven thousand but owing to the fact that this is a compilation or an addition in each case of quite a large number of

figures, I wish to place before you that I could have no such intention of accuracy but at the same time the order or the degree of credibility is much better than what a lawyer might call a "Guess".

Q Yes. Well to relieve Mr. Steer of the burden, I might say that at the bottem it says that they are a little better than guesses ?

A They are not as good as the figures might imply, if we did not put the qualifications on them.

Q I see. Then what have you to say, you compiled all these figures of 1922 down to the time that you started with the Pitot Tube in 1930, you compiled them from the best information you could get and I would like to know just how strenuously you went after that information, to get accurate information of past production?

A Well in answer to that I might say that when a person is attempting to get figures of this kind, if he has intelligent co-operation from the people most concerned you can do pretty well and if the people who are supplying the information have some ulterior motive you do not get such good results. In this case these earlier figures which are presented in this book which you have as the exhibit, were actually looked into by the Royalite Oil Company themselves. They wished themselves to know what had been going on. They set some of their staff deliberately to go through their records and then they came to me and brought what they had and said "How does this compare with what you have, let us put them together and see which is more credible" and some of these figures of the early date prior to

the time when I had anything to do with collecting the records, are very frankly those which have been voluntarily given me a later date by someone from the Royalite Oil Company who was making it his business of looking into the matter .

Q And that information with respect to the other three wells also came through Royalite, did it, or directly from the other wells?

A As to the wells not owned by Royalite I cannot say that. Now I might bring your attention to another page in this volume which may throw a little light on what you want. Page 52, volume 1; footnote:

"Early records of gas are poorly supported. Starting in May 1931 occasional Pitot Tube measurements were made. Records for 1928 - 1930 have been revised to meet probable conditions".

Q MR. BLANCHARD: Yes?

A In other words whilst compiling this book I got the information all tabulated in parallel columns and when I came to see the gas-oil ratios that were represented by my earlier guesses and that was all it was, about Vulcan, I considered that some revision was necessary in order to meet what was more probable in view of other wells that I was acquainted with, and those have very frankly been revised, and if I call it a guess at least it is based on a number of circumstances which dovetailed together and which is the best guess or best opinion that I could get.

Q Now then, going back to page 15 again, if I am not incorrect, I do not think we will trouble you to add it up, but the total production down to and including the year 1930, is shown by your summary on page 15, and amounts to 125,398,961,000 feet that is the total of gas and oil.

A Yes, the total amount for the year 1930 only, but the accumulative production of the field .....

Q I beg your pardon, it is 228 billion cumulative?

A Yes, that would be roughly of that order.

Q 228 billion cubic feet?

A Yes.

Q Now since the word "guess" has been referred to, both in a note at the bottom of page 15 and by my learned friend, Mr. Steer, would you care to venture your opinion as to how far out that cumulative production you have there might be, within what limits do you think you are right or wrong?

A You said 228, did you?

Q 228 billion, yes, a total of 228 billion?

A It might be either way from that 228, but not over 20% of say 45 million mcf.s one way or the other.

Q 45 billion?

A I would put that as an extreme limit.

Q You might be out either way 45 billion cubic feet?

A That is right.

Q All right.

A It is a small drop in the bucket.

Q That is what I am coming to. Now the total production of gas down to the end of 1944, do you know what that is? We have it, I suppose, from the exhibits.

DR. BOOMER: 1288 billion.

Q MR.BLANCHARD: 1288 billion. So that your error might be one way or the other, 45 billion out of 1228 billion?

A That is right. Three or four per cent.

Q Three or four per cent?

A Yes.

Q I think that is all.

Q MR. STEER: I am a little surprised at you making that 20% estimate in the light of your evidence, Mr. Beach, because as I understand your evidence the figure that you got you got from the Royalite Company?

A For their wells only.

Q And what you did was to take your own estimate or guess or whateger you like to call it, and then at some date a good deal later than the production had

actually occurred you got Royalite figures and then you and the Royalite representative set down and decided what it ought to be, is that right?

A We decided what was more probable.

Q Now that went on from the time that production was obtained in the gas cap until the establishment of this Pitot Tube system in 1930, is that right?

A Yes.

Q So that it went on over a period of six or seven or eight years. When was the first production from the gas cap?

A It was in October of 1924.

Q That was Royalite 4 wasn't it?

A That is right.

Q Were not there any wells in existence prior to that?

A Not producing from the limestone.

Q I see.

A There were wells producing from horizons above the limestone back in 1914.

Q Now you tell me that Royalite 4 was the first limestone well on the gas cap?

A The first well drilled into the limestone, yes.

Q And these five or six other wells, at least, four or five other wells, that you were able to get figures from in 1927, they were all drilled subsequently to Royalite 4?

A That is right. And if you will turn to Page 18, you can follow just the sequence of when they came in, at least, as to the year.

Q And when you place them under those circumstances that

error on figures obtained in that way can only be 20% either way, that is another guess, it cannot be anything else?

A It is an intelligent estimate which lines up with the available information, but admittedly a lot of it was based on what was happening in wells where metering or measurement of some kind went on.

Q What were you checking with the Royalite people, were you checking their metered production of wells or metered production of gas that was disposed of?

A Well, I might be explicit in that matter. A mimeographed form was prepared late in 1927 and beginning with January of 1928 was submitted monthly headed "Gas Production Statement", and the company submitted it, Royalite submitted one of those every month from January 1928 onward, so that I had something to go on. Now on that statement they explained the basis of how they arrive at these figures.

Q Well, what about those, have you got one of them here?

A No, I refreshed my memory this morning before I came down here.

Q Are they in your office?

A They are available, yes. And I might explain to you so that you will get the plan of it, Royalite 4 the quantity how it was arrived at, metered. Royalite 7, I do not know whether that is the one or not, the measurements made on the date given, and for February it might be that there was a measurement that was made in January, but they gave the number of days producing

and the basis of measurement made at a stated time.

Q Now what you say is that these records indicate to you the actual metered production from the well itself, is that it?

A Well, metered, yes, but in many cases based on a snap reading taken by the Company themselves.

Q Well then, from the time that those records were, from the time you began to get those records, would you be able to get for me a statement giving the total production from the time it came in to this date of Royalite 4?

A If we had the old files I presume we could, but I attempted to reproduce it here and present it to you as an exhibit.

Q And you tell me that from 1924 on, according to your information, Royalite 4 was actually metered at the top of the hole?

A I would not say it was all the way through. I know that it was not until after the well had been brought into control because it was on fire for two or three months.

Q Quite so. But after that you have those accurate records produced from the Royalite Company, have you?

A Well I have from January 1928, yes.

Q Well I am talking about 1924?

A Well I just explained to you that this form was prepared in 1927, and the first one was received in January 1928.

Q Yes. Now did you attempt to get any such similar figures from the Royalite Company for 1924 up to 1928?

A Well, subsequently they were given to me, yes, but I

didn't attempt to get them.

Q Were they given to you as being the metered flow of that well from 1924 to 1928?

A Not necessarily, no. It was not given that that was the production. I cannot say with regard to that now. I cannot say now in the light of many years whether it was metered or how it was, but from January 1928, or in January 1928 I happened to notice it is mentioned that it was metered.

Q And taking it from 1928 on, you can give us accurate statements as furnished by Royalite, of the metered flow of the well at the well head? I take that to be right from what you have said?

A Yes. Whenever metered, that is, but if it was not metered, that is different. It would be a fair estimate.

Q You went over the records today, this morning?

A Yes.

Q They should have been here, incidentally, but we will let it go.

THE CHAIRMAN: Surely the witness doesn't know what he is supposed to bring.

MR. STEER: Sure, sure, I quite appreciate that.

Q Now with regard to 1924 to 1928, you have got no such record?

A No, I cannot say that I have any records except what has been produced to me at the subsequent time when I was preparing this book.

Q And what you have given is a statement given you some

time after the well began to produce, given you by the Royalite officials?

A To tell you the truth, Mr.Steer, I am not nearly so much worried about the production from the Royalite wells as I am from some of the other wells who did not have engineers in the field and who did not care to show what they were doing. In fact, would prefer not to show how much gas they were making.

Q Your statement is that there were five or six of those between 1930 and 1944? There were five or six of those wells in that period?

A Now I said in 1927. If you come on to 1930 you will find that there must have been fifty or seventy-five wells producing then at the time that we began making regular snap readings of flow.

Q Up to the time of the installation of these Pitot Tubes in 1930, there would be about seventy-five more wells of which you would have to have a record?

A I would have to count them up. They are all there before you on page 18 and 19.

Q And you are not sure whether the production from 1924 to 1928 was metered or not?

A I know that only a part of it was metered, but I know that they were taking snap readings which gave them some kind of an idea, and I know that at some time, Okalta 1, for example, would flow at a tremendous rate and then would freeze up and woul be frozen up for some days and then would come in again. I would have to make inquiries when it froze up and when it came in again to make some kind of an estimate, and I did that currently

to have the information as to how many days there was of operation, at least, on some of these wells that were intermittent in production.

Q With regard to the wells that came into production, up to the installation of these Pitot Tubes, you are satisfied that the people were trying not to give you information?

A Oh, I would not say that.

Q You are satisfied that your information is far from accurate?

A Well I have put caution on these as to the reliability of the information, and I have given you my fair guess, which is, by the way, an maximum leeway, I think, but one which is supposed to be fair too.

Q You know that in the early days of the history of this field, there were tremendous quantities of the gas flared, don't you?

A Yes.

Q I would like to know whether your records are such as would include even your estimate of the amount of gas that was flared?

A Yes. I have tried to give a fair estimate of the amount that was flared, and on Page 15, the right hand column, headed "Waste", I have given that and I have given or made the reservation that some of the waste in the early years may actually have been put to some use in the field, but I have nothing to guide me in it.

Q Thank you, Mr. Beach.

Q THE CHAirman: Mr. Beach, will you please read the whole of that paragraph on page 15?

F. K. Beach.

A "NOTE: There was shallow production between 1914 and 1921, of which there is no record."

You see that I have purported to start with 1922 and I am telling you that I do not know what happened before 1922, but I have tried to give you what there is from there on.

"Early records of limestone production are little better than guesses."

I have amplified that statement already.

"Systematic Pitot Tube measurements at about monthly intervals started late in 1930. Metering started at most wells in October 1933, the base being 14.4 pounds and 60° Fahrenheit with no deviation correction. Deliveries to Calgary-Lethbridge system and other disposal items except field fuel have been metered throughout, the gas company base being 14 pounds and 50° Fahrenheit, without deviation correction. Waste, by difference, includes losses due to extraction of natural gasoline, sulphur, etc., and any differences in quantity due to change in base conditions."

In oth r words, I am telling you that the figure I have over here as waste has been arrived at after deducting a fair estimate of what was required for use as fuel in the field, and after deducting what was metered out to the Gas Company.

"From 1922 to 1926 no estimates of field fuel are available and total estimated production is sketchy. The difference between reported production and deliveries to the gas company

"pipeline is shown as waste, but waste should be diminished by whatever field fuel was used. Where field fuel is given (1927-1942) its quantity is estimated on the basis of rather wasteful use. If quantities reported as used appeared extravagant or if it appeared that they represented use by direct expansion without utilizing the heat value, they have been written down to a figure more nearly equal to heat value requirements.".

THE CHAIRMAN: Anything further from Mr. Beach, gentlemen? All right. We will adjourn until Monday morning at 9.30 A.M.

(The Hearing was then adjourned to 9.30 A.M. Monday, March 19th, 1945).

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